Curated Learning: A Pedagogical Approach To Maximise Learning Environments For Students' Deep Learning

Ethel D. Villafranca
MA Museum Studies
BA Philippine Arts
ORCID: 0000-0003-4944-3729

Submitted in total fulfilment of the requirements of the degree of

Doctor of Philosophy

November 2019

Melbourne Graduate School of Education
The University of Melbourne

Printed on archival quality paper

I dedicate thesis to my parents,

Aida and Ricky

Words cannot express how grateful I am

for the enumerable sacrifices and challenges they've had to overcome for us

I am who I am and where I am today because of them

ABSTRACT

Globally, billions of dollars have been allocated in developing highly adaptable, technology-infused, and connected learning spaces, called Innovative Learning Environments (ILEs), capable of accommodating a variety of pedagogical practices intended to equip students with skills and competencies critical for thriving in this rapidly changing world. However, research indicate that teachers are unable to fully maximise the potential of these ILEs. In contrast, many museums appear to have considerable success at intentionally manipulating learning environments and adapting pedagogy to suit intended learning outcomes. Understanding these museum practices may prove valuable in helping school teachers use ILEs better.

Two case studies were conducted to draw out strategies of museums in capitalising features of the learning environment to promote students' deep learning. Twenty-eight individuals from nine purposely selected institutions across Australia and New Zealand participated in this research. Thematic analysis of data from 42 observations and 25 interviews resulted in a proposition of a pedagogical approach, Curated learning, that leverages the interdependence between pedagogy and the built environment. Curated learning has the potential to help teachers use features and elements within their learning environment in ways that support students in developing deep learning competencies that, ultimately, will help them succeed in their academic, professional, and civic lives.

This research is embedded within an Australian Research Council (ARC) Linkage Project, called Innovative Learning Environments and Teacher Change (ILETC), that investigates how school teachers across Australia and New Zealand can utilise ILEs to improve pedagogy that leads to students' deep learning. Specifically, this research contributes to a growing body of international research on the effective use of ILEs and pedagogy. Furthermore, equipping teachers with the capacity to maximise ILEs will magnify the value of the financial investment and help them prepare students to thrive in this highly competitive and rapidly changing world.

DECLARATION

This is to certify that:

- this thesis comprises only my original work towards the Doctor of Philosophy except where reference is made in the text of it;
- due acknowledgement has been made in the text to all other materials used; and
- this thesis is no more than 80,000 words in length exclusive of tables, maps, bibliographies and appendices.

ETHEL D. VILLAFRANCA

PREFACE

Publications arising from this thesis

Refereed Conference Proceedings/Presentations

Healy, S., Grant, G., Villafranca, E., & Yang, P. (2015, June). *Beyond the bounded notion of the classroom: A theoretical orientation for evaluating the geographies of new generation learning environments.* Paper presented at Second Annual International Learning Environments Research Higher Degree Symposium, The University of Melbourne, Melbourne, Australia.

Healy, S., Grant, G., Villafranca, E., & Yang, P. (2015). Beyond the bounded notion of the classroom: A theoretical orientation for evaluating the geographies of new generation learning environments. In W. Imms, B. Cleveland, & K. Fisher (Eds.)*, Terrains 2015: Mapping Learning Environment Evaluation Across the Design and Education Landscape: An International Symposium for Research Higher Degree Students* (pp. 13-20).

Villafranca, E. (2016, June). *Understanding affordances in museum education context*. Paper presented at the Third Annual International Learning Environments Research Higher Degree Symposium, The University of Melbourne, Melbourne, Australia.

Villafranca, E. (2016). Understanding affordances in museum education context. In H. Micheltree, B. Cleveland, & W. Imms, W. (Eds.), *What's Working? Informing Education Theory, Design and Practice Through Learning Environment Evaluation* (pp. 113-118).

Villafranca, E. (2017, May). *Understanding affordances in museum education context*. Paper presented at the Museum Galleries Australia National Conference, Brisbane, Australia.

Villafranca, E. (2018, June). *Beyond these museum walls: Educators as curators of learning*. Paper presented at the Transitions18: Continuing the Conversation, The University of Melbourne, Melbourne, Australia.

Villafranca, E. (2018, June). *Museum educators as curators of student learning*. Paper presented at the Museum Educators, Evaluators and Technologists MEETDAY 2018, Melbourne, Australia.

Villafranca, E. (2019, December). *Curated Learning: Understanding how museum educators maximise learning environments for students' deep learning.* Paper presented at the Annual Australian Association for Research in Education Conference, Brisbane, Australia.

Invited Presentations/Workshops

Villafranca, E. (2018, May). *Curated Learning: Teaching strategies for collection-based classroom teaching.* Workshop with museum educators and school teachers. Museo De La Salle: Cavite, Philippines.

Villafranca, E. (2018, May). *Using Curated Learning for engaging gallery tours.* Workshop with museum professionals and tour guides. Bahay Tsinoy: Museum of Chinese in Philippine Life, Manila, Philippines.

Villafranca, E. (2019, February). *Curated Learning: The pedagogical relationship between museums and schools.* Workshop held at Talking Spaces 9: The Decade Ahead, The University of Melbourne, Melbourne, Australia.

Villafranca, E. (2019, March). *Curated learning: What's space got to do with it?* Presentation at the Designing Learning: MAAS Research Symposium – 2019 Sydney Design Festival, Sydney, Australia.

Digital media

Villafranca, E. (2019, November 16a). Pedagogical affordances (Version 1). figshare. doi:10.6084/m9.figshare.10314617.v1

Villafranca, E. (2019, November 16b). LEAD Framework (Version 1). figshare. doi:10.6084/m9.figshare.10315385.v1

ACKNOWLEDGEMENTS

This PhD journey of 80 thousand words.

First of all, I am grateful to the University of Melbourne for without the Melbourne International Research Scholarship and the Melbourne International Fee Remission Scholarship, I would not have been able to pursue this PhD. I would also like to thank the Australian Research Council for funding part of my candidacy through the Innovative Learning Environment and Teacher Change (ILECT) Project, within which this PhD research is situated.

The last 18 months of my candidature was like scaling a vertical wall, while carrying a full backpack, and after walking for 20 kilometres—on stilettos. A fellow PhD told me to look up online 'PhD and the Valley of Shit'. It was one of those many weeks when I was particularly struggling with thesis writing. Reading the essay confirmed that, yes, I was definitely right smack in the middle of the valley! That post led me to this other article, The Swamp of Sadness, by Anitra Nottingham (2016). She used the book, *The Never-ending Story,* as a metaphor for the PhD journey. Oh, how my heart—my 80s kid heart leapt! I remember the movie version of the book vividly. I loved the adventures of Atreyu with his luck dragon, Falkor. I cried with every misadventure he had to endure but also felt the jubilation when he triumphed in the end.

Nottingham (2016) said that most PhD candidates will eventually arrive at, what the movie called, the Swamp of Sadness. This, she emphasised, is a very difficult period in our candidacy, one that, sadly many PhD candidates know far too well—that point when everything seemed to be too hard, and every little step was excruciating. Some candidates, when they get to the swamp, panic and sink even faster. Others would freeze and sink quietly, without anyone around them even noticing. The third type, the survivors, she added, tends to look for a rope. A rope could be anything that will help you pull yourself out of the swamp—a conversation, a paper to read, an advice.

This, for me, was the most salient part of the article "… the people you surround yourself with in your thesis journey are crucial. Cultivate those who can throw you the best kinds of rope, so you can more easily believe in their rope" (Nottingham, 2016).

A long list of people, at various points in my PhD, have thrown me a rope and held on to the other end while I pulled myself out of the swamp towards thesis submission.

To the ILETC Project Team, foremost to Joann Cattlin for always looking after my best interest even though it was not part of her job description as Project Manager, thank you. I am also grateful to the chief investigators and my fellow PhDs in the project namely Fiona Young, Vicky Leighton, Anne Knock, Raechel French, Dion Tuckwell, Mark Osborne, and Dan Murphy, as well as our research fellows, Chris Bradbeer and Dr Terry Byers, for the illuminating conversations, insightful directions, and thoughtful suggestions.

This study would not have been possible without the study participants. While I cannot name any of them, I am indebted to them for their generosity with their time and expertise.

I am deeply grateful to the inspiring BoM-PhDs, Allen Espinosa, Bonita Marie Cabiles, Charles Siriban, Dr Dennis Danipog, Elizer Jay de los Reyes, Neslie Carol Tan, and OJ Serquiña for simultaneously keeping me sane while feeding my craziness—their company made endless write-shops at MGSE on weekends and during ungodly hours fun. This PhD would have been so lonely without their company.

I am also thankful to my fellow Pinoy PhDs, Dr Lem Lopez, Dr Lucille Lopez, Jacky Maestre, and Melvin Marzan for sharing resources, survival tips, and success stories. To Mike Malicsi, thank you for the friendship forged through FASTCO that continues to endure across time and space. Many thanks also to friends, museum colleagues, and former classmates, Ricky Francisco, Cecille Gelicame, Dr Jean Palmes, Carmel Baseleres-Muñoz, Dr Joanne Lim-Jaladi, Giselle Montero, Meah Ang-See, Maricel Montero, Dr Matthew White, and Ross Fitzpatrick whose support knows no time zone.

I had the good fortune of being assigned a desk in what became a micro-community of support. I thank Dr Sarah Healy, Dr Emily Wilson, and Alicia Mary Flynn for not just being wonderful PhD friends but also for being fabulous human beings—always ready with a relevant article to broaden my understanding or a cup of tea and a hug, whichever was most needed at the time. I would also like to thank other Level 3 PhDs and academics, especially Dr Kate Coleman and Dr Christine Redman, for always reminding me to celebrate even the small victories.

Writing this thesis was hard enough. Writing this thesis while holding on to a job in a field that I am deeply passionate about made it extra challenging. Thank you to my colleagues at the Museum of Chinese Australian History, especially to Vanessa Shia, Mark Wang, Melina Mallos, Lucy Tan, Luisa Teh, Erin Blackman, Pody Tung, Mian Wang, and Matthew Butler, for their patience, particularly during the last four weeks before submission when I could barely stay on my feet from lack of sleep and exhaustion. But most of all, for reminding me why I pursued a museum career. I am grateful. I am reminded that I am home.

To family and friends, near and far, my prayer warriors and my champions—there are too many of you to list here but thank you for all the love and support.

I am profoundly grateful to my parents, Aida and Ricky, for raising me to be resilient and equipping me with the tools that I need to reach for the stars. My siblings, Erwin and Eloisa, and sister-in-law, Arlene, for offering me a sanctuary especially when I needed it most. And my lovely nieces, Aerin and Arya, for the endless supply of cuddles and kisses—thank you from the bottom of my heart.

And most of all, thank you to my fabulous advisory committee headed by my committee chairperson, Professor Claire Newton, for their invaluable support throughout my candidacy. I would also like to thank Dr Heather Gaunt for her contributions during the early part of my candidature. Deepest gratitude to my principal supervisor, Associate Professor Wesley Imms, whom I met for a cup of coffee at the ground floor café of the Melbourne Graduate School of Education a week before I submitted my PhD application to the University of Melbourne. I knew then that I would be in good hands, and I was not mistaken. The phenomenal Dr Marian Mahat for going over and beyond the bounds of being a thesis supervisor and helping me through some of the toughest parts of my PhD journey, I am eternally grateful.

Thank you for never letting go of the rope.

(page intentionally left blank)

The best journeys

are the ones that answer questions

that at the outset you never even thought to ask.

Rick Ridgeway

TABLE OF CONTENTS

List of Tables

LIST OF FIGURES

This page intentionally left blank.

CHAPTER 1: INTRODUCTION

1.1 Motivation and Inspiration

This research was heavily informed by my experience as a museum professional and as a student. In the subsequent sections, I discuss my personal, academic, and professional background and how these shaped the direction of this study. I have included these sections as a way to recognise and acknowledge my personal experiences as these impacts my world view and thereby my interpretation of data from this research. As Fields and Kafai (2009) argued world view and bias of researchers are present in all social research since researchers, in conducting the research, navigate multiple cultural worlds—the worlds in which research participants exist and world in which the researchers themselves live (Denzin, 2009). Researchers are in a better position to see, hear, and interpret the behaviours of participants, and subsequently represent them in the data collected, when they recognise their own personal view of the world (Dibley, 2011; Fields & Kafai, 2009).

1.1.1 My museum experience

When I started my career in museums more than two decades ago in the Philippines, I did not know much about learning in museums.

My first museum role was as a Continuing Education Assistant at the Ayala Museum—a history, ethnographic, and fine arts museum located in the heart of Makati City, the business capital of the Philippines. I joined the museum in 1998, immediately after finishing a bachelor's degree in Philippine Arts, major in Arts Management, at the University of the Philippines. I was very green, wide-eyed, and idealistic. My primary responsibilities were organising and marketing museum education programs for the general public. In my undergraduate degree, we learned about the general principles of museums, but museum education was not part of the curriculum. What I knew then about museum education was, therefore, limited to what I had learned on the job and through conversations with senior museum colleagues. I scarcely had access to books on museum education, however, I took advantage of the limited amount of materials made available on the internet by overseas museums. By doing my own research and consulting with workshops facilitators of the museum, I learned how to design the structure and content of the education programs. I also facilitated some of the workshops, another skill that was also not part of my undergraduate training.

In less than a year, I transformed part-time offerings into year-long programs and expanded the range and variety of Ayala Museum's public offering. I organised activities for children that were anchored on themes relevant to the museum's collections such as paintings of the National Artist for Visual Arts, Fernando Amorsolo, abstract artworks of Spanish-Filipino artist, Fernando Zobel, archaeological artefacts, and the Dioramas of Philippine History. With the introduction of these novel programs, the museum came alive with a plethora of activities and people: young children doing arts and craft in one room, young adults experimenting with oil painting in the other, adults learning watercolour in another, literary aficionados in a gallery, and retired women blissfully stencilling and sponging their decorative trays in yet another room.

Additionally, the museum education programs did not remain bound within the premises of the museum. I expanded our teaching locations into parks, residential communities and shopping malls. I brought the education programs to business corporations by offering and designing customised courses to suit their requirements. These programs included various visual arts, pottery, decorative, and creative writing workshops for their employees and children of employees. Many of the programs were held within their corporate offices— in the meeting rooms, lobby, and even hallways of their buildings. In short, the education programs I organised were held in a wide variety and types of places, public and private spaces, inside and outside the museum's premises.

It was a profoundly enriching personal experience to have been able to bring the museum's education programs to marginalised sectors of the Philippine society (street children, orphans, and children with special needs) who do not usually have access to art and museums. I will never forget the eight-day workshop I co-facilitated in Marilac Hills, a halfway house for physically and sexually abused children, where we used art as a vehicle to provide participants with a short respite from their daily emotional struggles brought about by their traumatic experiences.

The museum's education programs were also successful financially, contributing a more significant amount to the museum's bottom-line than it had in the past. In barely six months, I met the 1.9 million Peso target annual income for the year 1999 of the continuing education unit (I was the only staff member of the unit). I was subsequently promoted to Senior Programs and Marketing Officer in 2001. The promotion meant that I also oversaw the tours unit in addition to the continuing education unit. This new role entailed working with schools and educational tour agencies to encourage them to bring students to the museum for school field trips. I also cultivated the museum's relationship with the local government of Makati City, where the museum was located, so that they would continue sending the city's public school students to the museum. It was around this time that the idea of corporate social responsibility started gaining momentum in the Philippines. In response, I started efforts in partnering with business organisations to sponsor public school students' field trips to the museum.

Perhaps the most significant experience that shaped my early professional development was receiving a fellowship grant from the Asian Cultural Council in 2001. Asian Cultural Council is a not-for-profit founded by John D. Rockefeller III in 1963 and remains the only organisation in the world with the sole mission of supporting cultural exchange between the United States of America (USA) and Asian countries (Asian Cultural Council, n.d.). Through the fellowship, I embarked on a five-month observation tour of various education programs in more than 80 museums in the USA. I also met and had conversations with dozens of museum educators. Part of the fellowship was an internship at the Education Department of the San Diego Museum of Art where I provided support for some of their education programs and helped develop online curriculum resources for teachers. The fellowship was an absolute eye-opener. It was inspiring to see an overwhelming number of programs and practices that may be adapted in the Philippines. Travelling to different places and interacting with people of various cultures and languages were tremendous learning experiences.

Visiting other museums and witnessing their education programs helped me realise the expansive range of programs that museums offer. I gained insights on which programs were popular and some understanding of the rationale behind why museums offered certain programs.

Brimming with ideas from the fellowship, I returned home in 2002 and immediately put some of these to work. I designed several interactive components that were installed in the Dioramas of Philippine History gallery, created a curriculum-based education program for small school groups visiting the museum, added new education programs for families, and introduced collection-based education programs for schools.

The trip provided invaluable insights and advanced my understanding of museums and museum education. This was critical because there was no degree in museum studies in the Philippines, let alone one that is focused on museum education. Yet, I still wanted a deeper understanding of the how's and why's of museum education. For example, what were the toddlers gazing up the Metropolitan Museum's ceiling while looking for fruits and vegetables learning? Why was I still able to vividly picture the hands-on carbon dioxide experiment that I participated in at the National Museum of American History when I could scarcely remember most of what we did in my high school chemistry class?

In 2008, I went back to the USA, on a Fulbright scholarship, to pursue my master's degree in Museum Studies at the University of Florida. I specialised in museum education and this broadened and deepened my understanding, among others, of learning in museums. I came home in December 2010 to continue my museum practice in the Philippines.

However, I still had more questions. What factors contribute to the effectiveness of museum education programs? Is it the immersive quality of the museum environment? Is it the objects in the exhibition that impact learning? Is it the museum educator's way of engaging the participants? It is likely a combination of these and more that make a difference, but how and to what degree?

How can we maximise the museum and its resources, including the elements within? Can museum educators' teaching practices support students' deep learning, defined in this context as "the process through which an individual becomes capable of taking what was learned in one situation and applying it to new situations" (National Research Council [NRC], 2012, p. 5)? What do museum environments offer in helping museum educators teach more effectively?

In recent years, the pressure to produce 'blockbuster' exhibitions, attract a broader audience spectrum, and increase overall numbers of visitors have resulted in museum workers focusing a majority of their work hours to meet these administrative targets. However, even without these targets, museum work can be quite demanding. As McCarthy aptly puts it, the demands of the job "often leaves little opportunity for reflection on practice" (2015, p. xiii). This research allows me with the opportunity to step back and reflect on my practice as a museum educator.

However, to present a clearer picture for my motivation in pursuing this particular research topic, I need to provide more context about my formal education experience in the Philippines.

1.1.2 My experience as a student

Growing up, I always felt that I was not as smart as my peers or siblings. While I received high marks, I had to work very hard for them—perhaps harder than many of my friends. I never felt good enough, adequate enough. I had always hated mathematics, chemistry, and physics as I struggled to connect concepts in these subjects with my life. I could not understand (and even resented) why I had to learn when Train A travelling at 250 kilometres per hour towards Train B travelling at 165 kilometres per hour will meet each other. I knew I wasn't dumb, but I didn't seem to learn the way other students learned quickly. Abstract concepts were hard for me to grasp. It did not help that classroom instructions were mostly teacher-centred—regardless of the subject matter. I remember spending most of my school days sitting inside single-cell classrooms, which were in the Philippine context rectangular boxes with windows on two sides. We sat in individual wooden chairs arranged in neat rows facing the front, where our teacher would usually be delivering her lecture. There would be between 40 to 50 of these chairs in each classroom. We learned about science, history, and language while sitting on those chairs and poring over textbooks.

I did not enjoy attending primary and secondary school as we were almost always "measured" by standardised tests and in other forms of assessments where I had to demonstrate my ability to memorise facts and regurgitate them to pass. Nevertheless, I worked very hard to get good grades. It was drilled repeatedly into us that "without good grades, you won't amount to anything in life".

I would hear lessons on mathematics, chemistry, and physics and I just almost always tuned out and told myself, "I cannot learn that, I'm not smart enough for that". Biology, though, was different. I liked my teacher. She was amazing. And, somehow, I was able to make connections between most of what she was teaching and what we were learning. I remember still collecting leaves from around our neighbourhood trees. We were instructed to press them onto booklets and write about what these plants were, its local and scientific names, but more importantly, how they were used medicinally. I had to talk to my mother and aunts about the different types of plants they knew and used for ailments. I also remember finding information about Filipino inventors and sharing in class their inspiring contributions.

My university experience was also very different. I enjoyed learning about most of the topics we had to study for my major (Philippine art history, art management). We still had those wooden chairs and single-cell classrooms with predominantly teacher-centred instructions. However, for courses that involved art and culture, our learning environment expanded outside of our classrooms and university campus. We went to museums, churches, and old houses. We went on trips to cultural communities where we talked to the people making elaborate embroidery designs on delicate fabric, we sampled food from provinces, and we participated in festivals and community gatherings. I remember one teacher who organised several trips so we could go to her house and see her collections of authentic and cultural objects. Another trip was to her friend’s house to see his collection of antique religious icons and jewellery, and elaborate Filipino furniture, the type that we almost only see in museums or in 19th century paintings. Can you imagine being able to look closely and handle (with gloves of course) precious material evidence of the richness of the Filipino culture?

I loved going to museums and heritage sites, seeing cultural objects and artworks, talking directly to people, and visiting communities where I witnessed traditional cultural practices in real life. I think that it was during this time that the seeds for my love for travel and life-long learning were planted. It wasn't to see something but to 'experience it' that I truly wanted. What got me excited. What fuelled me. What inspired me.

I pursued my master's degree in museum studies at the University of Florida from 2008 to 2010. Yes, the irony of almost hating school as a child but wanting to keep going and pursuing more academic degrees has not escaped me. It was while taking courses in museum studies that I confirmed—I truly do learn differently. I am an experiential learner. I am not a slow learner; I am just not what might be understood as a traditional learner. Hence, teacher-centred pedagogy alone is not as effective for me.

I also learned that there are different types of intelligences—not just the ones we get tested for in school—and these are not ranked hierarchically. Studying multiple intelligences, espoused by Howard Gardner (1985), made me understand that I have abilities that have value inside and outside the classroom.

My personal, academic, and professional context informed my choice of PhD research topic. On a personal level, I wanted to understand why I felt differently towards courses involving art and heritage. Was it the way my teachers taught those classes? Was it because our learning environment was no longer limited to the four walls of our classroom? Was it the close personal engagement with authentic objects embedded with history and culture? I realised that it is not going to school that I abhorred but the purely teacher-centred teaching that usually came with traditional learning environments.

Hence, this research is not just about investigating strategies of museum educators to help students learn better. It is, more importantly, about finding teaching strategies of museum educators that school teachers may employ so that their students will enjoy learning, realise the value of what they are learning, and help them develop skills that will remain useful beyond their academic life.

1.2 Research Questions

This research focuses on understanding how museum educators use the learning environment, including the spaces and objects within, to set-up conditions for developing students' deep learning. The primary research question informed the direction of this study:

> How do museum educators maximise the use of their learning environment to facilitate students' deep learning?

Three secondary research questions supported the analysis of the primary research question:

1. Where do museum educators teach student groups and what do these learning environments look like?
2. What elements are contained within these learning environments and how do they use these in teaching student groups?
3. What strategies do they employ in using the learning environment to encourage students' deep learning?

In the context of this research, the learning environment is viewed as having a multi-dimensional nature (Healy, Grant, Villafranca, & Yang, 2015). This means that the learning environment is not only composed of the physical but also includes the social, cultural, conceptual, personal, emotional, and cognitive aspects.

1.3 Research Aims

From the primary research question stems two main objectives:

1. Investigate strategies museum educators use for maximising features of the learning environment that facilitate students' deep learning.
2. Recommend strategies that school teachers can adopt in their classroom practice.

The value of museums on student learning has been clearly established by numerous research studies (Falk & Dierking, 1992, 1995, 1997, 2000; Hirzy, 1996; Hooper-Greenhill et al., 2006; McComas, 2006). Results from these have helped inform how museums design their exhibitions and develop education programs. Although great strides have been made in understanding the nature of learning in museums, much work is still needed so that this knowledge can be translated into practical application by museum professionals and educators beyond the museum field.

The Museum Association[1] in the United Kingdom shared news about two primary schools and a nursery in England that moved one full term of their classes into museums (Museum Association, n.d.). The project, ran by King's College London, aimed to investigate the benefits of long-term student placement within a museum setting (Cassidy, 2016). The study found that many of the students became more confident and effective communicators while their teachers demonstrated increased confidence in using out-of-classroom resources and spaces for teaching (King's College London, 2016). Clearly, there is value in school teachers using museums as a venue for conducting classes.

In the US, third graders from Grand Blanc City School spent five days at Sloan Museum as part of a pilot study to test whether there is value in school groups spending longer periods in museums (Ketchum, 2014). A formal report on this pilot study has not been published. This project as with the one in the UK, is indicative of the growing interest in investigating how museums can contribute to student learning beyond the often-brief school field trips.

In 2015, education practitioners from schools and museums gathered in Atlanta, Georgia, USA, for the inaugural National Association of Museum Schools (NAMS) conference (Merritt, 2015). NAMS is envisaged as a national platform discussing the museum school movement, sharing curricular approaches and ideas, and cultivate an environment of support for educators. As of 2019, NAMS

---

1 Museum Association is the London-based professional membership organisation for museum, gallery, and heritage professionals in the United Kingdom.

serves approximately 450 students in grades K-7 (National Association of Museum Schools, 2019). NAMS is one good model for a cohesive museum-school collaboration (Merritt, 2015) and underscores the value of the contributions of museum education to the school context.

My research aims to contribute to the growing body of evidence-based research on the valuable contribution of museums to teachers' practice. There are few recommendations on how museum educators' methods may be adapted into school classrooms (Museum Pedagogy in the Classroom, n.d.). This research aims to fill this gap by examining museum educators' strategies for utilising the learning environment to support students' deep learning.

1.4 Significance of this Research

This research is embedded within an Australian Research Council (ARC) Linkage Project called Innovative Learning Environments and Teacher Change (ILETC) that investigates how school teachers across Australia and New Zealand can utilise innovative learning environments (ILEs) to improve pedagogy that leads to students' deep learning. The four-year ILETC project is working in partnership with education departments in New Zealand and several Australian states (Queensland, the Australian Capital Territory and New South Wales) as well as Catholic Education Diocese of Parramatta, also situated in New South Wales. The ILETC projects also have key industry partners such as a furniture designer, ICT and acoustics specialists, school designers and their professional bodies, a museum, and leading research-focused schools.

Through the Building the Education Revolution (BER) program implemented in 2009, the Australian Federal Government committed $16.2 billion to construction and refurbishment of Australian school facilities that foster 21st century learning among its students (State of Victoria [Department of Education and Training], n.d.) However, Blackmore, Bateman, Loughlin, O'Mara, and Aranda (2010) found little empirical evidence that the built learning environment contributed to improved student learning. Furthermore, Hattie's (2008) synthesis of over 500,000 studies on influences that result in improved student learning in school reported that space barely made an impact on student achievement. He noted that one of the biggest contributing factors is the teacher, specifically "what the teachers know, do, and care about" (Hattie, 2003, p. 2). It is, therefore, the practices within these ILEs that the project focuses on. The ILETC project argues that changing the learning environment does not automatically result in improved teaching. It aims to demonstrate how maximising the use of ILEs facilitates improved teaching practices and learning outcomes.

In his opening address for the Terrains 2015: Mapping learning environment evaluation across the design and education landscape international symposium, Hattie, who is one of the Chief investigators of the ILETC project, said, "If you take teachers out of their egg crates and put them into fascinating and innovative designs, they teach the same way; it makes no difference" (2015, p. 11).

Why do teachers, arguably, teach the same way despite a change in the learning environment? The ILETC project hypothesise that unless teachers change their ways of thinking about how students can better learn in these spaces, then their teaching practices will remain the same.

I am one of seven PhD researchers in the ILETC project. Some of the other PhD researchers are architects, while others are school teachers—having different research foci on pedagogy, spatial competencies, measurement, change management, etc. I am the only museum practitioner among the PhD researchers in the project. The ILETC project has been designed so that each PhD researcher contributes a crucial part— a theoretical underpinning for what is essentially an applied research project.

One of the issues that the ILETC project is trying to address is that school teachers, it would seem, are not maximising the potential of ILEs to improve student learning. My research will focus on another type of learning institution, museums, that appear to have some success at utilising the environment to positively affect student learning. I am examining an aspect of pedagogy. Within that aspect is a unique condition because I am investigating museum educators who are giving their perspectives on a different type of pedagogy and under different circumstances but has a high validity to the concept of ILEs. By investigating museum educators' use of the learning environment, I aim to identify pedagogical strategies that they employ to maximise the potential of the learning environment in contributing to deep learning in students.

The primary contribution of this research to the ILETC project and to the field of education, therefore, is in exploring if and how strategies of museum educators can be applied by school teachers to their classroom practice. Specifically, this research will contribute in the following ways:

1. make more visible the role of the museum educators in setting up conditions that support students in enhancing their deep learning competencies.
2. make more visible the role of the learning environment in enabling museum educators in setting up these conditions.
3. make more visible the kinds of teaching that maximises the learning environment in setting up these conditions.

The physical dimension of the learning environment impacts teachers' pedagogy (McGregor, 2004). However, it is surprising that equipping teachers with the ability to maximise the learning environment does not always seem to be part of recommended strategies towards helping students achieve educational excellence (See Gonski et al., 2018). Since schools are "not inert shells", their physical design has profound impact on teaching and learning (Cotterell, 1984, p. 456). Both students and teachers consistently interact with and are immersed in the physical dimension of the learning environment throughout the many hours per day across many years that they spend in schools. The physical space and pedagogy are entangled. They cannot be separated as one influences, enables, or restricts the other. McGregor (2003) asserted:

> The role of the physical environment as a context for teachers' work has received little attention, despite surveys of workplace conditions suggesting its importance. Studies rarely go beyond suggesting the need for more decent space in order to improve motivation and enhance teachers' ability to work effectively. (McGregor, 2003, p. 358)

A study by Saltmarsh, Chapman, Campbell, and Drew (2015) highlighted the need to provide teachers with greater access to research-based resources and professional development focused on how to teach in non-traditional classrooms. Another study focused on gathering insights from teachers on how to increase deep learning adoption in schools conducted was conducted by Hathaway Communications (2018). They found that teachers did not need clarification on competencies necessary for students to succeed in school and in life. Instead, teachers expressed stronger interest in learning more about how they can implement in their classrooms practices strategies that support deep learning core competencies (Hathaway Communications, 2018).

This research examines the interrelationship between different aspects of the learning environment and strategies teachers can utilise to assist students in developing deep learning core competencies. I am bringing in the perspective of museum educators to help teachers understand how they are using the learning environment to support students' deep learning. As Evans (1995) pointed out, although museum settings present a valuable resource in investigating the intersection between the learning environment and learning, this opportunity is underutilised and largely ignored. Based on reviews of literature, there is insufficient studies that examine the relationship between museum education, learning environment, and deep learning, a gap that this research aims to address.

1.5 Key Terms

This study focuses on phenomena which could be defined and investigated in many ways. In this section I provide description of key terms used within this thesis. In doing so, it provides clarity for the scope of the study and enables more precise analysis of the findings. The key terms are further explored in the context of the literature reviews in chapters 2 and 3.

Affordance	As action possibilities (Hammond 2010; Heft, 1989; McGrenere & Ho, 2000; Turvey, 2012) arising from

	perceived and actual functional properties of an object (Pea, 1993).
Deep learning	The process of developing skills that will allow students to apply learning from one learning area into another learning area or to a completely different situation (National Research Council, 2012).
Excursion	Structured activities facilitated by a museum staff or volunteer for school groups during visit to the museum.
Incursion	Structured activities designed for school groups and conducted outside the museum's premises by a museum staff. Other museums use the term outreach program to refer to these.
Learning environment	The place where the participants conducted the education program – where the 'teaching' happened. In the context of this research, the learning environment is composed of the material, social, cultural, conceptual, personal, emotional, and cognitive aspects.
Museum	"A non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study, and enjoyment" (International Council of Museums, n.d.).
Museum education programs	The set of activities organised by museums that apply teaching and learning principles to help facilitate meaningful experiences of their various audiences.
Museum educator	Staff who actively and purposely facilitate the learning experience of students during their museum visit and may include, but are not limited to, museum education staff, curators, and docents. These individuals may be paid employees or volunteers.
Pedagogical affordance	Possible uses of an element of the learning environment to facilitate the learning of another individual.
Pedagogy	"Pedagogy encompasses that act [teaching] together with the purposes, values, ideas, assumptions, theories, and beliefs that inform, shape, and seek to justify it" (Alexander, 2008, p. 75, emphasis in original).

1.6 Structure of this Thesis

The subsequent chapters of this thesis are structured as follow.

Chapter 2: Mapping the museum context. In this chapter, I engage with the literature within which my research questions are situated. I begin by exploring the museum context, particularly, the curatorial process involved in creating exhibitions then launch into an investigation of teaching and learning in museum learning environments. I continue with an examination of the concept of affordances, how it has been applied in various disciplines, and the dearth of studies linking affordances and museums.

Chapter 3: Deep learning. This chapter is the second of two chapters focused on exploring literature that are relevant to this research. I investigate the development and application of the concept of deep learning into classroom teaching. Before concluding the chapter, I emphasise the need for more studies centred on teachers and their use of the learning environment for students' deep learning.

Chapter 4: The theoretical framework. In this chapter, I expound on the theoretical framework that I utilised to inform the direction of data collection and analysis of this research. I start with an explanation of the Contextual Model of Learning (Falk & Dierking, 2000, 2013) and consequently explain how this theory was reified in my research.

Chapter 5: Research design and methods. In this chapter, I discuss the research design and methods that I used to answer the research questions. I begin with an explanation of the qualitative case study approach that was chosen for this research. This chapter also reports on the site and participants selection processes, the various methods utilized for collecting and analysing data, and the observation checklist developed for this study.

Chapter 6: Physical context: Places for teaching. This chapter is the first of three chapters where I report on my findings and answer questions about where participants of this study conducted programs for school groups. I start with various places within the museum's premises that participants used during the Excursions into museums case study then continue to discuss other types of locations where participants taught programs during the Incursion into schools case study. This chapter also includes descriptions and photos of the various learning environments that participants used. I end this chapter with a discussion of the two types of venues that were used across the two case studies.

Chapter 7: Personal context: Pedagogies of the learning environment. This chapter is the second of three chapters where I report findings from my data collection. In this chapter, I provide empirical evidence to respond to the research question about what and how museum educators use various elements contained within their learning environment to teach student groups. In the first and second sections, I elaborate on the elements within the learning environment and how participants of the study used these in teaching student groups. I close this chapter with a discussion on pedagogical affordances.

Chapter 8: Sociocultural context: Museum educators and deep learning. In this final chapter where I report findings from my data collection, I focus on museum educators and their practices related to students' deep learning. Data presented in this chapter respond to the research question around the strategies that museum educators utilise in making use of the learning environment to support students' deep learning.

Chapter nine: Curated learning. This chapter draws from combined findings throughout the research study to propose a pedagogical approach that takes into consideration elements of the learning environment to assist educators in supporting students develop their own deep learning competencies. I open this chapter by introducing Curated learning and explain its theoretical and practical links to the practice of curating in museums. I continue with an elaboration of the five principles that underpin Curated learning and articulate which deep learning competencies each principle promotes. I end the chapter with a discussion of factors that impact museum educators' capability in using the learning environment for students' deep learning.

Chapter 10: Conclusion. In this concluding chapter, I offer a summary of the thesis, discuss the conclusion, contributions, implications, and future directions of this research. I start by providing an overview of the study. I continue with an exploration of how this study contributes to research and its implications to teachers' classroom practice. I also offer ideas on the directions for future research concerning teacher's use of the learning environment to support students' deep learning.

CHAPTER 2: MAPPING THE MUSEUM CONTEXT

Due to my personal context presented in Chapter 1, I initially explored literature relevant to museums and museum learning. In this chapter, I mapped out the context of teaching and learning in museums to support the contention that practices of museum educators have great potential for influencing students' deep learning. I investigated learning in museums before delving deeply into museum educators' teaching practices, particularly those involving students. I also outlined the historical development of the curatorial practices in museums and subsequently explore the idea that school teachers can be curators of their learning environments. I end with a discussion of the theory of affordances and its application to teaching in museums.

2.1 Learning in Museums

The International Council of Museums' (ICOM) definition of a museum clearly positions museums as educational institutions. ICOM defined a museum as:

> A non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study, and enjoyment. (ICOM, n.d.)

Some professional museum associations consider institutions that have living collections (such as aquaria, zoos, arboretums, and botanical gardens) as museums. For this study, I have excluded these types of institutions from this research because the types of learning environments of these institutions markedly differ from school environments. In the context of this study, I used the term museum to refer to art, history, natural history, archaeology, ethnography, and children's museums, along with science centres and planetarium.

Museums did not always have a strong focus on education and were mostly concerned with safeguarding cultural and scientific treasures. According to Hopper-Greenhill (1991), museums were not generally regarded as educational institutions. This changed by the beginning of the 19th century when museums (usually built along with libraries, lecture rooms, and even laboratories) became places where people could acquire knowledge and educate themselves. During World War I, museums took on a more active role in assisting with children's schooling, oftentimes stepping in when war disrupted school because teachers were drafted or school buildings were requisitioned (Hopper-Greenhill, 1991). She explained that, through exhibitions, museums helped communicate to the general public important information ranging from infant care to suggestions on improving people's lives. After the war ended, educational agencies wanted museums to create closer partnerships with schools but curators resisted (Hooper-Greenhill, 1991). However, when appeals, notably from teachers, to make museums more accessible intensified, museums acquiesced (Hooper-Greenhill, 1991). Arrangements were subsequently made for special teachers to work with school children and by the 1960s the term 'museum education' connoted museum activities that involved working with schools (Hooper-Greenhill, 1991). It was also around this period when museum education came to be recognised as a profession requiring specialised training different from those undergone by a school teacher or a curator (Hooper-Greenhill, 1991).

Over the years, the terminology referring to the act of knowledge-construction in museums has constantly shifted. Lately, it may be observed that many museums prefer to use the word 'learning' instead of 'education'. This may be because the word education connotes that these programs were designed for school children or those who still require formal education. Conversely, the term learning suggests a lifelong process not limited to only certain ages or groups. Ambrose and Paine (2012) contended that learning in museums is not about teaching facts but sowing "a seed of interest, a spark of inspiration" (p. 63). For this study, I use the term museum education to refer to activities that apply teaching and learning principles to help facilitate meaningful experiences of the museums' various audiences.

In modern art museums, a museum educator is someone knowledgeable, creative, and skilled as a teacher, advocate of visitors, and creator of meaningful interactions between visitors and art through a range of educational endeavours

(Williams, 1988). Although this description was developed for art museum educators, the same characteristics and role can be applied to museum educators in other types of museums. As stated in the definition, museum educators cater to various kinds of museum visitors. However, for this study, I focus only on engagements between museum educators and school students.

I have provided a brief overview of learning in museums. I will now focus specifically on student learning within the museum context.

2.1.1 Student learning in museums

Numerous studies provide significant evidence that students learn in museums (Falk & Dierking, 1992, 1995, 1997, 2000, 2013; Hirzy, 1996; Hooper-Greenhill et al., 2006; McComas, 2006). Even John Dewey's (1902/2009) vision of a model school included a museum. Several studies present evidence that school field trips to museums carry a long-term impact on students (Falk & Dierking, 1997) and result in remarkable experiences especially for those who are still in primary school (Falk & Dierking, 1995). Researchers also found that students were still able to recall content or subject-matter related information even years after their museum visit (Falk & Dierking, 1997). Furthermore, as a result of these museum visits, students benefitted educationally by gaining new knowledge, skills, and inspiration (Hooper-Greenhill et al., 2006). Hirzy (1996) argued that museum visits could assist students in developing qualities that will not only impact their test scores.

> Museums can offer a counterbalancing curriculum, stressing the development of critical judgment, awe, piety, sensitivity, empathy, affection…provide an alternative set of experiences that seek to transform and improve learners, not merely to improve their statistical performance. (Hirzy, 1996, p. 64)

Howard Gardner, an American educational psychologist, asserted that museums have the capacity to engage students, stimulate their understanding, and encourage them to take control of their future learning (as cited in

McCommas, 2006). Museums make content and difficult ideas more accessible by providing connections to disparate ideas, facts, and feelings that may lead visitors to see things in a new light (Falk, Dierking, & Holland, 1995).

Hooper-Greenhill (1991) reported that teachers were aware that museums offered experiences that were different but complementary to the classroom. She added that visiting museums not only made it possible for students to explore alternative ways of learning but also provides them with an opportunity to actively engage with material evidence through first-hand encounters with the collection and the museum itself. The physical departure from the classroom, going to a new place, meeting new people, trying new approaches to gathering information, and personal encounters with real objects, according to her, were stimulating and motivating experiences for students. She also argued that going to museums allowed students the opportunity to put into perspective and apply what they have learned in school as well as demonstrate skills and abilities not usually seen inside the classrooms.

According to Falk and Dierking (2000, 2013), the rich and multi-sensory experiences offered by museums are excellent stimuli for meaningful learning. They argued that learning of museum visitors, including students, is influenced by the interplay of the following three distinct contexts: the personal context, the sociocultural context, and the physical context. Based on the Contextual Model of Learning, decisions that museum visitors make are “filtered through the personal context, mediated by the sociocultural context, and embedded within the physical context” (Falk & Dierking, 2013, p. 30).

While numerous studies have established that students learn in museums (Falk & Dierking, 1995, 1997, 2000, 2013; Falk, Dierking, & Holland, 1995; Hirzy, 1996; Hooper-Greenhill et al., 2006; Koran, Longino, Shafer[2], 1983; McComas, 2006),there needs to be more empirical evidence that students are able to take what they have learned in museums and apply it to other situations. This ability to transfer knowledge from one context to another is an outcome of deep

[2] Lynn Dierking published as Dierking-Shafer and Shafer in the past.

learning (NRC, 2012). According to the National Research Council (2012), when students engage in deep learning, they have the ability to achieve academic and personal success.

I have summarised the literature on student's learning experience in museums. I will now concentrate on how museum educators facilitate learning experiences of students in museums.

2.2 Teaching in museums

Research on students and museum learning have largely focused on students and their learning process (Yoo, 2019). Less attention has been given to how museum educators teach within the museum environment and the effects on student learning of their practices. I reviewed literature on education interwoven with research on learning in museums to deduce commonalities between effective approaches used in museums for teaching students. Four key themes emerged from the literature:

- There is a shift in authority between educators and students.
- Students are given more control over their own learning.
- Social learning is encouraged.
- The museum, as a unique learning environment, is maximized.

It is important to note that in reviewing literature, I excluded pre-and post-visit activities for students as well as museum programs held outside the museum's premises. These four themes focused only on teaching sessions that occur within the museum's premises. As explained in Chapter 1, I used the term 'museum educators' to refer to individuals that actively and purposely facilitate the learning experience of students during their museum visit. In this review of literature, these facilitators of learning are not limited to staff employed by the museum but also include other individuals who facilitate student learning in museums such as school teachers, docents[3], museum guides, facilitators, gallery educators, and volunteers.

The four themes enumerated above are grounded in a constructivist view of teaching and learning. Constructivism defines knowledge as temporary, developmental, and both socially and culturally mediated (Brooks & Brooks, 1993). This theory took its roots from works of developmental psychologists such as John Dewey, Jean Piaget, and Lev Vygotsky. While all three psychologists viewed knowledge as self-constructed, each one had a slightly different interpretation on how this knowledge is constructed. In Dewey's experiential learning concept, he contended that individuals learn better when they are given the opportunity to engage in activities that require them to apply whatever concept they are trying to learn (Hein & Alexander, 1998). Jean Piaget, the major proponent of psychological constructivism, theorised that an individual's capacity to construct knowledge increases as the individual graduated to higher stages of cognitive development, while Vygotsky, a social constructivist, emphasised the importance of language and social interaction in learning (Abdal-Haqq, 1998). In constructivism, according to Brooks and Brooks (1993), learning occurs when individuals reconcile their pre-existing knowledge and experience with new information they encounter. When confronted with an idea, object, or phenomenon that does not make sense to them, individuals either interpret this to conform to their present set of rules for explaining and ordering the world, or they create a new set of rules that accommodate what they thought was happening (Brooks & Brooks, 1993).

In the succeeding section, I expound on the four themes that appear to contribute to effective pedagogy in a museum setting.

[3] Docents are adult volunteers who lead groups of visitors on an educational or informative tour of the exhibition galleries of museums or historical sites (Neill, 2010).

2.2.1 There is a shift in authority between educators and students

In a traditional learning situation, such as in a classroom, the teacher is considered the authority figure. In these situations, more often than not, students are viewed as empty vessels waiting to be filled with knowledge by an authority – the teacher (Hein & Alexander, 1998). Teaching in other informal learning environments, such as a museum, has the potential to disrupt this power dynamic. A study by Frelin and Grannäs (2010) found that places outside classrooms blur and make the fixed relational conditions between teachers and students ambiguous. The word 'potential' is key because some museum educators have the tendency to teach the way they were taught and follow the familiar teacher-student script where the teacher is considered the expert; the student relegated to being a novice. As Hattie (2015) pointed out, teaching the same way in a different environment is ineffective. What works, he added, is when educators act as a guide or facilitator for students' learning. Instead of being the expert, the educator should take on the role of a "co-explorer who encourages learners to question, challenge, and formulate their own ideas, opinions, and conclusions" (Abdal-Haqq, 1998, p. 2).

Michaela Ross was one of the workshop leaders at Tate Modern's series of workshops designed to help parents and very young children develop confidence in exploring and engaging with artworks in the galleries (Ross, Hancock, & Bagnall, 2004). She had this to say about her role in the workshops, "I think it is important not to set yourself up as an expert, as someone who has 'the right answers'" (Ross, Hancock, & Bagnall, 2004, p. 26).

This shift away from the expert role allowed for multiple interpretations, deviated from having just one correct answer, and placed value on students' prior knowledge. Kenkmann (2011) noticed that when she brought her adult education German language students to an art museum, they were more open to expressing their opinions, gave more spontaneous responses, and were less worried about making mistakes. In her case, the traditional expert-novice structure was disrupted because since she is not an art expert, she and her students were almost on a level playing field.

2.2.2 Students are given more control over their learning

Studies have shown that students learn better when they are given a greater sense of control over their own learning (Falk & Dierking, 2000). Griffin (2011) concluded that efforts should be made to help students understand the purpose and learning agenda for their museum visit. She added that giving students a choice on what they will be learning and allowing them to choose how to record information they are collecting lead to better learner engagement. In a study by Groundwater-Smith and Kelly (2003), a group of students identified completing detailed worksheets as an impediment to learning. The students focused on finding answers to all the questions, and this prevented them from exploring the exhibitions on their own (Groundwater-Smith & Kelly, 2003). These findings align with the Contextual Model of Learning (Falk & Dierking, 2000, 2013) in that it underscores the significance of choice and control in learning.

2.2.3 Social learning is encouraged

The previously mentioned study by Groundwater-Smith and Kelly (2003) involved upper primary and secondary students in Australia taking photos and creating a poster of specific aspects of the museum that helped or hindered their learning. They identified that students' enjoyment from learning with, and from, their peers as one of the factors that was helpful in facilitating students' learning. The importance of social interactions to learning is reflected in both social constructivism (Vygotsky, 1978) and the Contextual Model of Learning (Falk & Dierking, 2000, 2013).

Educators who subscribed to a constructivist view promoted group learning between two to three students by allowing them the opportunity to discuss approaches in finding solutions to problems with little interference from the teacher (Yaeger, 1991). By working together, students can learn from each other. In contributing individual members' prior knowledge to the collective knowledge of the group, students have the opportunity to see different perspectives about one concept, various solutions to a problem, or varying points of view about issues. For instance, project MUSE (Museums Uniting with Schools in Education)[4] reported that students saw more details on an art print when they took turns in verbally sharing out loud their observations and noticed details that they would not have seen on their own (Davis, 1996). Working with other students forced students to articulate thoughts, concepts, insights, and questions. Sharing these with their peers may help them reconcile issues they are facing and, thereby, result in better understanding.

2.2.4 The museum, as a unique learning environment, is maximized

The term learning space and learning environment are often used interchangeably. In this thesis, I am using learning environment. Literature on museum education identifies museums as an informal learning environment. However, a definition for the term 'learning environment' does not appear to be available in this field. Hence, I turn to the field of education research for a definition.

The term learning environment usually does not refer to the physical learning environment and instead points to the social, psychological, or conceptual environment (Cleveland, 2009). However, Alterator and Deed (2016) argued that the learning environment is comprised of the "physical, visual and metaphorical iteration of space and can be used in delicate mix of all three". The Organisation for Economic Co-operation and Development (OECD, 2017) defined the learning environment as an organic whole, larger than specific classes or programs, that embraces the experience of organised learning for groups of

[4] Project MUSE was a research project of the Harvard Graduate School of Education's Project Zero that involved museum educators, school teachers, and principals from the USA and other countries in Asia, Europe, Australia, North America, and South America. The goal of the research was to investigate the students' process of learning in art museums.

learners centred on a single "pedagogical core" (p. 16). They added that it is not just a location where learning takes place but also incorporates the activities and outcomes of learning.

Similarly, my views on what encompasses a museum's learning environment go beyond the physical and built aspects of the place where the museum educator teaches and students learn. It is not limited to the "material location in which education research is located" (Leander, Phillips, Taylor, Nespor, & Lewis, 2010, p. 331). In investigating the learning environment, I embrace Soja's (2014) view of space as multi-dimensional, simultaneously encompassing the "real-and-imagined" (p. 177), the social and material, shrouded in "impenetrable mystery" and, therefore, not "completely knowable" (p. 177). As stated in the first chapter, I take a more holistic view of the museum learning environment as the interaction of the material, social, cultural, conceptual, personal, emotional, and cognitive aspects.

In education, one approach that takes into account the impact of the learning environment on student learning is the Reggio Emilia Approach, which considers three educators in the classroom: (a) the teacher, (b) the student, and (c) the environment. When educators take into account the environment as the 'third teacher', they become conscious of the possibilities that manipulating and utilising space has on student learning (Ellis & Strong-Wilson, 2007). The J Paul Getty Museum in Los Angeles, California, illustrates how museums could apply the concept of the environment as the third teacher (Bell, 2010). The museum complex was designed to provide visitors with certain kinds of experiences that start with the tram-ride from the parking area to the complex, including sitting in the gardens and piazzas, as well as the opportunity to see panoramic views of the city (Bell, 2010). Experiencing areas outside the exhibition galleries was also considered an important part of the school field trip and contributed to student learning (Bell, 2010).

The immersive quality of museum exhibitions transports the visitor into a different time and place, real or imagined, by putting them inside a three-dimensional representation of this 'world'. Immersive environments engage multiple senses of visitors. Some museums exploit sight, sound, smell, touch, and even taste to create the illusion of being somewhere else. Emerging scholarship supports the idea that engaging multiple senses leads to a better acquisition and retention of new concepts, knowledge, and ideas (Hannan, Duhs, & Chatterjee, 2013).

Museums can be excellent story-tellers, and they utilise objects in their collections to engage visitors in their narratives. Bedford (2014) explained that the story is "what happened" while the narrative is "how the story is told" (p. 57). She added that telling stories is inherent among humans – that we both tell stories and seek them out even at a very young age. The narrative mode is both interpretive and interactive; it initiates a conversation while encouraging the listener to be open-minded (Roberts, 1997). Research has shown that we are able to quickly absorb and remember information when these are delivered in the form of a story. Using stories in exhibitions for children and families is popular because stories can trigger strong emotional resonance among viewers. Powerful narratives have the capacity to transport visitors to a different time and place, engage them emotionally, spark their imagination, create connections, and make them care about someone or something (Bedford, 2014).

In the early days of exploring 'affect' in museums during the 1990s, Roberts (1991) declared that due to the "profoundly affective" (p. 17) nature of museums, the role of affect in learning should be of interest to museum professionals. Traditionally, affect was examined and defined through the lens of psychology and closely linked with Bloom's taxonomy that categorises learning into three domains: cognitive (remembering, combining, and synthesizing information); psychomotor (muscular skills, manipulation, and coordination); and affective (feelings, emotions, attitudes, and values). However, new philosophical explorations relating to affect have since emerged, such as those of Gilles Deleuze. Peralta (2015), explained that Deleuze's post-subjective theory of affect leads to a more expansive view that bodies, objects, spaces, and the environment also hold affective powers. He, however, cautioned that affect "should not be confused with sentiments, emotions, and feelings" (p. 304). In this light, affect is seen as "a response to stimulus" (Peralta, 2015, p. 304) as well as "an ability to affect and be affected" (Massumi, 1987, p. xvi).

Mulcahy (2016) applied this Deleuzian philosophy in investigating the potential of affective learning in museums. Her study focused on a selected sample of primary school students during their visit to specific exhibitions in three different museums in Melbourne, Australia (Melbourne Museum, the Immigration Museum, and Scienceworks). Findings from her study indicate that "affective capacities of bodies are central to learning and can travel from one learning location (museum) to another (classroom)" (Mulcahy, 2016, p. 207). She concluded that affective learning in museums leaves a lasting impression, one that is potentially transformative in nature. Additionally, Lord (2007) stressed that the value of the museum experience lies in the affective and transformative quality of the experience because of its potential to change visitors' attitudes, interests, appreciation, and beliefs. Similarly, Roberts (1991) insisted that the multi-sensory, three-dimensional, and interactive qualities of museums naturally appeal to the part of the brain concerned with space, image, and affect. Results from previous studies have found that when asked to remember their museum experience, most individuals, even after 20 or 30 years, could still easily recall what they saw, did, and felt during their visit (Dierking, 2002).

Despite the fact that curators recognise the impact of affect to knowledge-building, most consider this as accidental and uncontrollable, and therefore not exploited when developing exhibitions (Roberts, 1991). This practice of prioritising rationalism and objectivity over emotional experience, cognitive over affective, continues to persist among curators even with the widely accepted reality that visitors feel as well as think when they visit museums (Watson, 2015).

There was a time when the primary concern of museums were the acquisition and preservation of precious objects—"museums are guardians of the material evidence of our culture - physical proof of our triumphs and failures" (Villafranca et al., 2017, p. 163). Objects in museums serve as reminders of how we were, what we have achieved, and what we have also lost, but beyond that, objects are also powerful tools for teaching. Objects "hold multiple stories and meanings, and, depending on the context, all those stories and meanings are potentially valid" (Roberts, 1997, p. 3). Lubar and Kendrick (n.d.) proposed several ways of thinking about objects or artefacts in the context of history. For them, artefacts tell their own stories, connect people, mean many things, capture moments, and reflect changes. They added further that artefacts bring memories to life and make history real. Paris wrote, “authentic, unique, and first-hand experience with objects stimulate curiosity, exploration, and emotions” (2002, p. XIV). This is what sets museums apart from other informal learning venues. Kirk asserted that due to museums’ “rich storehouse of resources, of evidence, of sources, and of artefacts” (1987, p. 22), they are well-positioned to support the kind of teaching and learning that modern education requires.

The unique power of objects in conveying ideas has long been recognised in the museum field. “Learning from real things and real places, talking, handling, discussing, reviewing, comparing, recording and presenting” (Hooper-Greenhill, 1987, p. 44) are methods used by museum educators on a daily basis. “Each artefact in a museum provides a potential learning ‘portal’ and embodies multiple, often, contradictory ideas and narratives” (Boys, Boddington, & Speight, 2013, p. 174). During the last four decades, engaging in active and experiential learning in schools has been gaining traction. Object-based learning (OBL), which utilises principles of active and experiential learning, was introduced to encourage learning (Hannan et al., 2013). Initially restricted to students of archaeology or geology, OBL has now been employed as a teaching method in other disciplines such as medicine, biology, journalism, and business management (Hannan, et al., 2013).

A study by Hannan et al. (2013) found that 61% of the 154 University College London students they surveyed considered OBL as a more effective way of learning than listening to teachers talking or delivering lectures. These students, who come from various disciplines including biology, geology, anthropology and medicine, were asked to answer a set of questions after an object-based teaching session. However, the researchers did not specify the focus of the lessons, hence, this conclusion may or may not apply across all disciplines. They also reported that aside from improving subject-specific knowledge, students also developed transferable skills such as teamwork, communication, and observation skills.

Table 2.1 outlines potential learning opportunities that OBL and learning with museum objects afford students. This demonstrates that learning with actual objects has the potential to help students progress from basic observation skills to more complex conceptual and creative thought processes.

Table 2.1

Education 'levels' and learning objectives across museums and universities

Level	Learning objectives
Basic: Understanding what is there	Learning to look: developing powers of observation, curiosity, attention to detail, descriptive abilities, visual literacy, object/spatial/visual analysis
	Haptic learning through touch: developing awareness of tactile and tacit knowledge through senses, feelings and memories
	Engaging with materials, objects and spaces thorough hand, eye and body: developing drawing, making, performing, story-telling as forms of recording and expression
Intermediate: Building from what is there	Generating inspiration: developing abilities in lateral thinking, creativity and the exploration of both emotional and intellectual ideas
	Providing a reference point: offering models and patterns (material, form, colour, structure, interrelationships) as sources of further enquiry
	Learning complex analysis across multiple variables: understanding the connections between material things and their processes of production and consumption, within specific historical, geographical, political, economic, social and cultural contexts

Level	Learning objectives
	Designing sequences and narratives: selecting and combining elements for specific purposes, curating, exhibition, events organization
Advanced: Integrating what is seen with what is known	Engaging with alternative perspectives: undertaking and understanding complex interpretations, dealing creatively and critically with the unfamiliar, developing second order thinking, making persuasive arguments
	Imagining alternative scenarios: exploring translational and transformational changes through making and remaking ideas, texts, things and spaces
	Doing applied research: developing ideas, hypotheses, undertaking investigations and evaluations, drawing conclusions, making recommendations
Professional: Transforming what is there	Generating new propositions: challenging existing knowledge, creatively and critically disrupting existing assumptions, designing improvements, understanding and managing complex change, innovation, creative entrepreneurship

Source: Boys, Boddington, & Speight, 2013

In art museums, objects used by museum educators for teaching school groups include works of art such as paintings, sculptures, drawings, photographs, installation, and film (Bell, 2017; Cramer, McLeod, Craft, & Agnelli, 2018; Downey, Delamatre, & Jones, 2007; Sedernerg, 2013; Winstanley, 2014;). On the other hand, live animals, scientific specimens, simple machines (lever, pulley, and fulcrum), and specialised machines (such as Van de Graaf generator, robotic rover) were among the objects that museum educators in science museums use (Oliver, Fergusson, Mahony, Oliver, Kingsley, & Browne, 2015; Tran, 2007). Some museum educators also used art supplies (Bell, 2017; Downey et al., 2007), maps (Sederberg, 2013), exhibition labels (Allard, Boucher, & Forest, 1994), artefacts and archaeological materials, documents (Bell, 2007), and even everyday objects such as scissors, pencil, clipboard, paper (Hubard, 2015), plank of wood, and empty water bottle (Tran, 2007). Aside from objects, museum educators also used other elements of the learning environment for teaching students. These include sounds (Hubard, 2015), text, interactive exhibition components, natural environment, and sensory stimulation such as temperature, lights, and shadows (Bell, 2017).

The combination of objects, wall's colours and placement, light levels, sounds, smells, digital media, technology, presence of other museum visitors, conversations with peers, wall texts and captions, as well as emotional responses elicited by exhibition narratives are part of what makes the museum learning environment unique. However, far too little attention has been paid to investigating how these impact pedagogical approach of museum educators or how they are utilising these environmental features to improve student learning. To understand what museum's learning environments can offer to assist pedagogy, I am going to trace the theory of affordances beginning from Gibson's (1979) conceptions in ecological psychology.

Theory of affordances

In psychology, affordances originally pointed to perceptions of humans and animals of their surroundings. When it was utilised by Gibson (1979) in ecological psychology, he used the term to refer to environmental properties that allow the actor within that environment possible actions.

> The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill. The verb to afford is found in the dictionary, the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment. (Gibson, 1979, p. 127)

He attached affordances to fundamental elements of the environment such as substance, medium, surfaces and their layout, objects, other persons and animals, and finally, places and hiding places. He also provided a few examples to illustrate this concept: Air affords breathing, unimpeded movement relative to the ground (which affords support), and visual perception. Water, on the other hand, affords drinking, pouring from one container to another, bathing, or washing. Surfaces, such as the ground, as mentioned earlier, afford support, walking, running, or standing.

Pea (1993) defined affordances as perceived and actual functional properties of an object that determine how it could possibly be used. This aligns with how the concept is viewed in the field of design—as inherent qualities of a product that provide user with cues on how to use or interact with said product (Norman, 2013; Knaflic, 2015). Knaflic (2015) provided the following examples: (a) a knob affords turning, (b) a button affords pushing, and (c) a cord affords pulling. He further argued that products with good design have sufficient affordances that silently direct users how to correctly it.

It is important to note that the existence of affordances does not automatically lead to a specific action or behaviour but rather they contribute to the possibility for that action to occur (Greeno, 1994). In his definition, Gibson (1979) highlighted the relational aspect of affordance – that it exists within the relationship between the animal and the environment. For example, when a person enters a room with a staircase, it does not mean that he will use this to ascend or descend to a different level. However, the staircase affords him with the ability to possibly do so. Additionally, another individual may perceive an alternative set of affordances for the same object and may use it differently (Gibson, 1979; Norman, 2013) Heft (1989) added that affordances are situated in a specific time and place and "is perceived in relation to some intentional act" (p. 13). Going back to the person and the staircase, when the person enters the room and sees the staircase, he will use it if he *wants* or *needs* to ascend or descend to a different level. As Gibson (1982) explained, "needs control the perception of affordances (selective attention) and also initiate acts". In this light, affordances may be viewed as action possibilities (Hammond, 2010; Heft, 1989; McGrenere & Ho, 2000; Turvey, 2012) specific to the object's user.

The theory of affordances has been applied to various disciplines such as design, architecture, technology, special education, and even communications. Lindberg and Lyytinen (2013) provided a summary of the various disciplines where the concept has been used (**Table 2.4**). They also identified how each discipline defines the theory of affordances.

Table 2.2

Definition of affordances across different disciplines

Authors	Definition	Context
Norman (2002)	perceived and actual properties of things that determine usage	design of everyday items
Gaver (1991)	properties relevant for interaction	human–computer interaction
Pfaffenberger (1992)	perceived properties that suggest multiple usages depending on perceptions	explicating the political process of shaping technology
Greeno (1994)	affordances are intertwined with aptitudes on the part of actors	psychology
Gaver (1996)	human-relative environmental attributes, primarily related to action and interaction	social and material aspects of design
McGrenere (2000)	Gibsonian definition but adds varying degrees of affordances	software interfaces
Hutchby (2001, 2003)	functional and relational aspects that enable agentic action in relation to artefacts	philosophical account of human–technology interactions
Elliot and Hearst (2002)	usable features of an artefact (largely atheoretical)	human–computer interaction
Conole and Dyke (2004)	ways in which things can be used in	information technologies in an educational context
Xiao (2005)	implicit and largely materialist	technology in healthcare settings

Authors	Definition	Context
Koutamanis (2006)	Gibsonian definition, though ironically recognizing the influence of culture	architectural design
Fayard and Weeks (2007)	perceived possibilities	interactions in office spaces
Xiao et al. (2007)	performative definition, does not include Gibson in its nomological net	whiteboards in trauma centre operating suites
Maier et al. (2009)	affordances indicate action potentials and usefulness	architectural design
D'Adderio (2008)	relies on a Gibsonian definition but gives materiality an active ontological stance	explaining the role of materiality in organizational routines
Leonardi (2010b)	material properties that can lead to action	explaining materiality
Vilar et al. (2011)	atheoretical and descriptive	videogame design
Zammuto et al. (2007)	affordances invite and constrain certain usages	a holistic perspective on technology and organizations

Source: Lindberg & Lyytinen (2013).

Together, these studies provide insights on various interpretations and applications of the theory since Gibson (1979) first proposed it. However, Oliver (2005) lamented that the definition of the term has become muddled, so much so that "it is now too ambiguous to be analytically valuable" (p. 402). Although extensive research has been carried out on affordances, in the museum field, inadequate number of investigations has been pursued. Only a few studies that examined affordances in the museum context exist. One of these studies was conducted by Trondle et al. (2014) who found that curatorial decisions related to the exhibition space (such as specific arrangement of artworks, choice in wall colour, and differences in floor surfaces) affect visitor attention and inform their behaviour within that space. In another study, Achiam, May, and Marandino (2014) followed 12 visitors in a natural history museum and they concluded that affordances of the exhibition space dictate the interpretive strategies these visitors employed in their meaning making process. For example, the museum's discovery room afforded touching and manipulating objects, which in turn, afforded active examination of said objects. They also learned that being able to stand close to animal displays in exhibition galleries afforded visitors with a sense of authenticity in terms of the size and feel of these animals as well as its imagined characteristics. Also, putting similar objects closely together in a cluster afforded comparison between these objects to figure out similarities and differences.

A recent study on affordances of learning environments was completed by Young, Cleveland, and Imms (2019). This research is of particular interest because it is perhaps the only research thus far that has investigated affordances of a museum classroom in relation to teacher pedagogy and deep learning. They collected data from five research sites, which included two primary schools and one museum. Among the 30 participants were two museum educators, while the rest were architects and school teachers. Their focus was on identifying affordances in classrooms that educators perceive as contributors to effective teaching and learning. They argued that the concept of affordances may serve as a bridge to help architectural designers and users of learning environments understand each other better and lead to creation of settings that are more effective for teaching and learning.

They reported that participants were able to identify the greatest number of affordances for teaching and learning in the museum's learning space. They also found that settings that can be reconfigured multiple ways, have flexible furniture, allowed for students to collaborate, and provided students with easy access to resources were most valued by participants. Many of the participants also perceived that features of the learning environment, which support deep learning included those that enabled them to create different settings to accommodate different ways students worked, offered areas where students could work together, made digital resources easily accessible, allowed for presence of other students, and gave students the choice to sit down or stand while working (Young et al., 2019). Although the study provided valuable insights on museum classrooms and affordances for teaching and learning, findings specific only to the museum were not included in the report. Additionally, the study focused on perceived instead of actualised affordances. This meant that a clear demonstration of how the features of the learning environment were used in practice was still lacking. This is another gap that my research hopes to address by providing examples of how the learning environment is actually used to encourage students' deep learning. The word encourage is key here because my research, as you will read in the Research Design and Methods chapter, does not include students as participants. Therefore, whether museum educators' strategies subsequently lead to students' developing deep learning competencies is outside the scope of this study. I will discuss deep learning in more detail in the next chapter.

In light of how I am investigating use of the learning environment in this study, it seems that defining affordances as action possibilities (Hammond 2010; Heft, 1989; McGrenere & Ho, 2000; Turvey, 2012) arising from perceived and actual functional properties of an object (Pea, 1993), mentioned earlier in Chapter 2, is more suitable to the context of this thesis. This lack of research on affordances and museums is a critical oversight. In many cases museum curators and museum educators intentionally manipulate the museum environment to cultivate effective learning with, arguably and in many instances, considerable success. I argue that identifying and understanding affordances of the museum learning environment is vital in maximising its pedagogical possibilities. Furthermore, using the theory of affordances (Gibson, 1979) to examine how museum educators can achieve this success would have significant ramifications for how school teachers can possibly learn to intentionally curate their classroom and adapt pedagogy to suit. This is a gap that my research also seeks to address.

2.4. The practice of curating in museums

Nowadays, it has become quite common to hear and read the word 'curated' in ordinary conversations and non-museum publications. The title 'curator' is no longer limited to professionals tasked to conceptualise and organise museum or gallery exhibitions. The verb 'curate', traditionally associated with museums, has now gone beyond the bounds of this discipline. It is no longer unusual for the title of a curator to be bestowed upon people who put together web content, experience, cuisine, performance, music, or even store merchandise.

The shift in the meaning of the word curator is not new, nor was it originated by museums. Robins (2005) traced the etymology of the word to its connection with the church. Derived from the Latin word cura, which means 'care', she added that this title was formerly assigned to someone who has a cure or charge. She continued to say that those given this title, eventually, were not limited to those with ties to the clergy and included individuals who were:

- appointed as guardian for a minor or someone who is mentally unstable;
- offering a cure for the soul;
- assigned as manager or steward; and
- a keeper or custodian.

She drew comparisons between a parish curate and the gallery curator. In the same way that the former looks after his parishioners and their spiritual well-being, the latter looks after museum collections and also, perhaps, the visitor's cultural well-being (Robins, 2005).

However, in most modern medium to large museums, the curator's role has evolved to include scholarship and setting up exhibitions in such a way that knowledge about objects will be more accessible to the general public. Looking after collections has become the primary responsibility of the collections manager while taking care of general well-being of visitors has been relegated to the museum's visitor services unit. Hence, curating is not just a matter of displaying museum objects. The curatorial process involves selection, juxtaposition, and interpretation of objects (Robins, 2005). Embarking on this process requires that the curator: 1) engage in research; 2) select and collect objects to support chosen exhibition narrative; 3) interpret individual objects and draw connecting threads among different selected objects; 4) organise content and annotation; and finally 5) present the narrative to the audience through an exhibition or another medium (Wolff & Mulholland, 2013). Numerous studies have proven the value of exhibitions for learning (see: Falk & Dierking, 1995, 2000, 2013; Hein, 1998; Hopper-Greenhill, 1992; Koran, Longino, Shafer, 1983).

Literature teems with discussions centred on how to organise museum exhibitions to promote effective learning (Matusov & Rogoff, 1995). For example, optimum height with which to hang artworks, limitations on how many objects per display case, size and number of words in labels, and even duration of visitor attention have been well established (Serrell, 2015).

Museum professionals, particularly curators and museum educators, select and interpret objects as well as manipulate spaces within the museum for learning in different ways. Curators specifically select objects, arrange gallery spaces, and use text to communicate the exhibition narrative. Museum educators, on the other hand, do not generally have authority to manipulate gallery spaces and select objects to display. However, they do get to choose specific objects and areas within the exhibition to use for the museum's guided tours and other education programs. Some museums have dedicated learning spaces or classrooms that museum educators can curate to suit specific education program requirements. If museum educators are responsible for promoting visitor learning, then it may be argued that they too are curators, albeit curators of learning.

It is important to note that the practice of curating learning is not limited to the museum field. Some school teachers already do this in their classrooms through the display of objects, images, and text, by changing classroom lay-out, or transforming the whole room into another place or time to support their students' learning objectives (Godinho & Imms, 2011).

This practice of curating the classroom is also not a novel idea. In 1965, a primary school teacher in Tasmania, Australia, transformed her classroom into an imaginary ship that sailed across the different continents (Godinho & Imms, 2011). In the 1970s, Heyman (1978) advocated for manipulation of "changeable features" (p. 18) of the classroom by applying environmental psychology principles to education. He identified furniture, wall and floor coverings, and everything portable as part of these changeable features. Those that cannot be changed, such as the walls and windows, he called "fixed features" (Heyman, 1978, p. 18).

I will now focus on literature that explore how teachers can curate their learning environment.

2.4.1 Teachers as curators of the learning environment

A comprehensive search using a combination of search terms that include ‘curating’, ‘curated’, ‘teaching’, and ‘learning’ on various ERIC databases did not yield any relevant results for studies on teachers curating their classrooms. I broadened my search and used words related to ‘curate’ such as ‘manipulate’, ‘manipulating’, ‘objects’, and ‘spaces’ in the context of classroom environments. There appears to be a limited number of empirical studies investigating the effect of manipulating spaces and objects on teachers’ instruction. However, these studies examined classroom features separately. For example, Fitzpatrick and Angus (1975) prepared a report on a study involving 27 teachers working in open space schools in Australia. In the context of their research, open space schools pertained to schools that did not use single-cell classrooms. The authors concluded that while many of the participating teachers in the study regarded the concept of open space schools as a positive innovation, not all teachers were capable of teaching in classrooms within an open space school. Some teachers who were fully competent teaching in traditional “self-contained” (p. 43) classrooms did not achieve their teaching goals when they were transferred to classrooms in an open space school.

Another study analysed school environment perception of 11 middle school teachers (Gehrke et al., 1982). The authors found that most teachers did not use the environment or see its potential as a curriculum variable; instead, they manipulated the classroom to control student behaviour. Teachers were more concerned with using the environment to minimise disruption instead of maximising instruction. They rarely used wall spaces for instructional purposes. If they displayed students’ works, these were either for decorative purposes or to make students “feel good” (Gehrke et al., 1982, p. 7). However, one teacher claimed that he put up provocative questions and posters to encourage inquiry. Since the majority of the teachers indicated that they have limited understanding of how to use the environment for curriculum and instruction, the authors recommended that pre-service teachers should be provided professional development to help them understand uses and effects of the classroom environment.

Creative Connections, a 1999-2003 research project in the UK sought to explore 1) how Art and Design teachers use galleries/museums in London as a learning resource; 2) the role of In-service Education and Training (INSET) and Continuing Professional Development (CPD) in the promotion of the effective use of these resources; and 3) the role of the gallery/museum educators and the professional relationship they have with teachers (Robins, 2005). The Creative Connections project informed the study by Robins (2005), which was focused on finding out how well Art and Design teachers engaged and understood curatorial issues and practices. He argued that teachers' level of understanding of curatorial issues and practices has implications for their ability and willingness to utilise galleries/ museums as a learning resource. While the study was not about manipulating objects and spaces in the classroom, it has been included because it provided insights into some issues that are relevant to curating the environment for learning. Results from the study indicated that many of the teachers who participated lacked awareness or familiarity with current curatorship issues.

Furthermore, only a small number of participants considered understanding the curatorial role as relevant to teaching and learning. Roberts (Robins, 2005) concluded that teachers learning about the curatorial process could provide an opportunity for them to acquire and develop new strategies for teaching and learning in galleries and museums. I argue that all future teachers (not just those who major in art and design) should learn about curatorial practices. Teachers are not generally trained to perceive the relationship between the learning environment and effective teaching nor are they taught how to manipulate their learning environment to reinforce their practices (Newton, 2009). It is possible that learning about the curatorial process may enable teachers to transfer curatorial knowledge into their classroom practice. Unfortunately, courses on curatorial issues and practices are usually limited to museum studies and other museum-related degrees.

At the University of Memphis, Bobick (2012) conducted a study aimed at investigating pre-service art education students' feelings of competence and comfort in teaching in a museum setting. Eight undergraduate pre-service art education students participated in the study and designed art activities for the Brooks Museum of Art's family day event. The hands-on art activities were inspired by objects from the museum's collections. The participants were surveyed after the event. She found that undergraduate art education students benefitted from an authentic museum education experience and working alongside members of the museum's education team. She concluded that including museum education in the undergraduate art education curriculum will be a good way to help prepare art educators for their future professional practice.

Teaching with Intention (Miller, 2008), while not an empirical study, is still worth mentioning. Miller emphasised the importance of creating classrooms that are "literate and purposeful, organised and accessible, and most of all, authentic" (p. 17) and advocated for teachers to ensure that their classrooms supported their teaching and learning beliefs. She shared her conversations and interactions with some of the teachers she worked with, such as Katy, who was a new teacher. Initially, Katy felt that she had no control over her classroom environment and did not feel empowered to make changes to the room she inherited. However, discussion with her students helped Katy think and plan changes she would implement in the classroom. Katy's students mentioned that not having enough room to spread out or walk around, disliking their assigned seats, and having difficulty in finding books they wanted hindered their learning. Miller (2008) also highlighted the significance of making learning and teaching visible by utilising classroom walls. She stressed that it is also important to showcase not only the evidence of learning but also the process students and teacher underwent to get there.

2.4.2 Impact of curating the classroom on students

Similar to studies investigating the effect of manipulating spaces and objects on teachers, there is also a dearth of research focused on how manipulating spaces and objects impact students. The relevant results from this broad search were studies that usually investigated a specific classroom feature.

According to Morrow and Rand (1991), the positive developmental dividends from manipulating classroom environments have already been established by recent studies. For their research, they recruited 170 children in 13 middle-class pre-school or kindergarten from various schools to test whether “the design of classroom environments can positively influence literacy development” (p. 396). The purpose of the study was to determine whether environmental changes and teacher behaviour would result in increased spontaneous literacy behaviour of young children during their class’ free-play period. In the context of their study, environmental changes meant adding into the classroom various literacy-related materials such as books, magazines, multiple types and sizes of papers, construction papers, stapler, blank booklets, pencils, felt tip markers, coloured pencils, and crayons. Teacher behaviour pertained to teachers pointing out materials, explaining their use, and guiding the children in using these. Spontaneous literacy behaviours referred to reading, writing, and paper-handling. They found that participants were likely to voluntarily engage in more literacy behaviours during free-play periods if literacy materials were introduced and when teachers guided them in using these.

Another classroom feature commonly altered that has been extensively researched, but still widely debated by educationalists, is the arrangement of students’ desk and chairs (Higgins, Hall, Wall, Woolner, & McCaughey, 2005). McKenna (2011), a teacher in Portland, Oregon, used seating arrangement as a metaphor to teach his students about life outside of school. This is not an empirical study nor about classroom environment manipulation per se. However, what is valuable from this article were the student responses captured by McKenna (2011). Student feedback mentioned in this article supported findings of Gehrke et al. (1982), which indicated that teachers used seating arrangement for classroom management.

Furthermore, students felt that classroom seating arrangement affected their interaction with other students and ultimately, their learning (Gehrke et al., 1982.) Another study with similar findings was conducted in a rural community college established in 1925 (Veltri, Banning, & Davies, 2006). The authors did not provide further information about the participants except that they were students in a community college. According to the students, factors that negatively influenced their perception of their classroom environment included inadequate space, furniture, seating arrangements that hindered interaction between students, and inability to see visuals presented by their teacher. On the other hand, they identified furniture that allowed group work and interactions along with the ability to see presentation visuals as having positive impacts to their classroom environment.

A pedagogical approach that significantly considers the importance of the physical environment on student learning is the Reggio Emilia approach (Gillespie, 2000). When educators take into account the environment as the third teacher, they become conscious of the possibilities that manipulating and utilising space has on student learning (Strong-Wilson & Ellis, 2007). I used 'Reggio Emilia' with 'effect/impact' plus 'student/children' or 'teacher' to search academic journals for relevant empirical studies. Surprisingly, there were only two results that I found valuable in the context of the classroom environment.

The first study involved 21 teachers (including special education associates and family workers), about 100 children, and their parents for a research project conducted in six Head Start classrooms across Iowa, which adapted the Reggio Emilia approach (Gillespie, 2000). Teachers made environmental changes and noticed that these were the changes that resulted in the "most obvious, immediate, and satisfying results" (Gillespie, p. 22). One staff member who added 'homey touches' in the housekeeping area noted that dramatic play in that area not just increased but became more appropriate. They also reported that adding mirrors, light tables, and clear containers where materials were stored resulted in children using a wider variety of materials that were made available to them.

The second study is an ethnographic research on a Reggio Emilia-inspired preschool classroom in Ohio and explored how the natural sciences were represented in the classroom (Inan, Trundle, & Kantor, 2010). Results from studying 18 pre-schoolers, ten teachers, and a program director pointed towards the value of intentionally creating a science-rich environment to trigger, and subsequently, support pre-school students' curiosity and, consequently, engage their hearts, heads, and hands with science.

Understanding how to effectively select objects, furniture, and other materials to be included or removed from classrooms and how to arrange these may have significant ramifications for improving classroom pedagogy, and ultimately, positively impact student learning. Based on the scant result of the literature review, an investigation on how facilitators of student learning (whether in museums or schools) curate their learning environment is warranted. As Evans (1995) pointed out, museum settings present a significant, yet mostly neglected, resource for studying the relationship between the physical environment and learning. After all, Winston Churchill once said that "we shape our buildings and afterwards our building shape us" ("Churchill and the Commons Chamber," 2016).

2.5 Summary

In this chapter, I mapped the context for learning in museums, specifically that of students. I also examined practices of museum educators that relate to teaching students and identified four trends from literature that point to effective teaching practices in museums. I then discussed the theory of affordances as a possible lens through which to understand possibilities for using the learning environment to support students' deep learning. Lastly, I traced the historical development of curatorial practices in museums and explored the idea of school teachers as curators of their learning environments. In reviewing the literature, I have identified a significant gap that requires further investigation: understanding how museum educators utilise affordances of the learning environment to improve student learning.

In the next chapter, I will focus on the type of learning, deep learning, that museums appear to espouse.

CHAPTER 3: DEEP LEARNING

In the previous chapter, I discussed the kind of learning that museums facilitate. Many of the descriptions identified earlier refer to a kind of learning that may be applied outside the academic context, a key characteristic of deep learning (Chow, 2010; Fullan, Quinn, & McEachen, 2018; National Research Council [NRC], 2012; Warkentien, Charles, Knapp, & Silver, 2017; William and Flora Hewlett Foundation, 2013). In this chapter, I focus on deep learning. I begin by providing a historical overview of the concept. Due to lack of empirical studies on deep learning in museums, I engage with the concept through literature related to schools and deep learning. I end the chapter with an exploration of the relationship between deep learning and the learning environment.

3.1 Historical overview of deep learning

There has been a great deal of research on surface and deep learning that has resulted to these becoming well-established concepts in educational research (Mahat, Byers, Bradbeer, & Imms, 2018). Although a number of researchers have advanced our understanding of the concept of surface and deep learning, Marton and Säljö (1976) were the first to apply the concept as a way by which students approached learning (Mahat et al., 2018) and introduced the term "approach to learning" (Entwistle, 2001, p.5). In their study, Marton and Säljö (1976) instructed 40 first-year university students in Sweden to read three sections from a textbook. They examined the approaches that students took in completing this task by dividing them into two groups and giving them a set of questions after they completed each section of the assigned text. For the first two sections, the groups were given different sets of questions. They gave the first group questions that required a deeper understanding of the text that they read. In contrast, the second group were asked questions focused on factual information from the text. Both groups received the same set of questions for the third section. This last set of questions was a combination of the two types of question from the prior sets, some required thorough understanding while others asked for detailed factual information.

They found that some students focused on gleaning out the big ideas and understanding the text while others focused on memorising facts and details from the text that they thought they would be asked about later. The former is now known as deep approach to learning while the latter as surface approach to learning. Students who adopted a deep learning approach study for meaning and understanding (Greasley & Ashworth, 2007). These students were intrinsically motivated to learn, actively engaged with the content, and elaborately explored the material, which then led to meaningful learning (Golightly & Raath, 2015).

Subsequent researchers have since explored and put forward their contributions to the concept. According to Beattie, Collins, and Mcinnes (1997), four groups of researchers have expanded the distinction between deep and surface learning.

- Marton and Säljö (1976) distinguished surface and deep learning through student's intention for learning
- Pask (1976; Pask & Scott, 1972) identified two different types of learners: serialist and holist
- Ramsden and Entwistle (1981) focused on student's motivation for studying: personal meaning, reproducing, and achieving
- Biggs (1978, 1979) centred on the approach that students took while studying and proposed a third type, achieving

The first group, led by Marton and Säljö (1976), has already been introduced above. Additionally, they distinguished surface and deep learning through student's intentions. They said that the former was limited to earning a passing grade while the latter focused on understanding and constructing meaning from what the student was studying. With deep learning, the intention was to understand and place meaning on content versus minimal engagement with the task to earn a passing mark, which was a surface learning intention. Their study also found that many students were capable of using both surface and deep learning strategies, which meant that learning approaches exist on a continuum. Their study established that students adapted the way they learned based on what they perceived were required of them.

Around the same time that Marton and Säljö (1976) were developing their ideas on surface and deep approaches to learning, Pask and Scott (1972, 1976) were also reporting results of their own experiments with students in the United Kingdom. In their study, they used species of imaginary animals and instructed students to figure out its taxonometric principles by identifying the defining features of these animals. Results from these studies led them to conclude that there are two dichotomous types of learners: a serialist and a holist. According to them, a serialist learner drew simplistic, sequential connections by using low order relations as a strategy to remember relevant facts and essential information. In contrast, a holist learner, actively engaged with the material, connected abstract concepts and ideas, and utilised higher order relations (Pask & Scott, 1972). A serialist preferred to adopt a cautious yet logical stance by following a step by step and highly structured learning, focused on the topic in isolation but concentrated on details and evidence (Entwistle, 2001). On the other hand, the holist learner actively sought connections between ideas, preferred to use their personal organisational strategy by building their overview of the topic, and greatly benefitted from illustrations, analogies, and anecdotes (Entwistle, 2001).

The methodological approach undertaken by Marton and Säljö (1976), and Pask and Scott (1972) involved testing students in the context that closely resembled how they studied everyday then interviewing them to gain better clarity on the process students undertook to complete their assigned task. This approach has contributed significantly to subsequent researchers' ways of thinking about teaching and learning in higher education (Entwistle, 2001). However, Ramsden and Entwistle (1981) thought that organisational factors might have influenced decisions made by students in completing their academic tasks. An earlier study by Ramsden (1979) seemed to have indicated that some university lecturers' teaching methods facilitated a deep approach while others created academic demands that forced students to use surface approaches. Students interviewed for the study clearly expressed their perception that lecturers influenced their approaches to study. To mitigate this issue, Ramsden and Entwistle (1981) developed a questionnaire that determined students' perceptions of their course.

Additionally, they developed an inventory of approaches to studying, which initially included 15 sub-scales but was later reduced to just three motivation-driven orientations linked to outcomes for studying: personal meaning, reproducing and achieving. They explained that students who were motivated only by extrinsic means, such as fear of failing the subject, chose surface learning with a reproducing approach, and demonstrated pre-occupation with complying with requirements of the syllabus. They added that students who were intrinsically motivated pursued a deeper approach. These students demonstrated genuine interest and were capable of integrating ideas, connecting evidence, and developing logical conclusions (Ramsden and Entwistle, 1981). Lastly, they contended that students with achievement motivation exhibited a more systematic method for studying.

In 1970, Biggs (1970) reported results from a study involving 314 university students in Australia. He administered a 72-item Study Behaviour Questionnaire to students enrolled in education during orientation week (before academic lectures started) and then again shortly before final exams of the year. He found that students' study strategies could be classified under two classes: simplifying and opening-out. He explained that simplifying strategies, while efficient, involved low-level methods of accepting and assimilating of facts without further understanding or sophisticated interpretation. He added that if a student had a good memory, then he/she used that to concentrate on the most relevant information and only studied materials that were listed as required reading. This strategy was chosen by "students with 'pass only' aspirations" (Biggs, 1970, p. 162). In contrast, the opening-out strategy involved a more sophisticated approach where the student organised content based on self-generated structures and when confronted with novelty and complexity, the student remained open-minded and read widely to enhance understanding of the topic (Biggs, 1970).

Biggs (1987a) argued that three factors influence institutional learning: presage, process, and performance. He explained that presage factors were independent of the learning situation and exist prior to the student entering a learning situation (Biggs, 1987b). Presage factors include personal and situational factors, the former referred to personal aspects of students (such as intelligence, home background, and personality characteristics) while the latter included situational context related to the learning institution (such as subject content, teaching and evaluation methods, and course structures) (Biggs, 1987a, 1987b).

Biggs (1987a) further argued that indirectly or directly, the presage factors impacted performance of students through its influence on the process Factors, which informed the way the student went about learning. Similar to Ramsden and Entwistle (1981), Biggs believed that motivation for learning affected the process with which students engaged with the materials they were studying. However, he added that the student’s approach “is a composite of a motive and an appropriate strategy” (Biggs, 1987a, p. 9). He gave the following scenarios to explain motive and strategy: Intrinsically motivated students read widely, related new content to their prior knowledge and, as a result, tended to get the most meaning from their learning. Students whose motivations were to achieve high grades were likely to organise their work while those whose motivations for learning were only to pass their subjects with the least amount of effort had the tendency to simply focus on bare essentials and rote learning (Biggs, 1987a).

The three scenarios described above correlate to three learning approaches that Biggs (1987a, 1987b) proposed, namely deep, achieving, and surface. He added that deep learning is not the quality of knowledge that students have or develop but how they engaged with the academic material or completed a task related to their studies. The achieving approach, he explained, required students to organize their time and working environment. Similar to Marton and Säljö (1976), Biggs (1970) also believed that students were capable of switching between approaches.

The third factor, performance, were highly influenced by the cognitive and affective dimensions. The cognitive dimension was related to factual and structural aspects of learning while the affective dimension concerned feelings towards or as a result of the student’s learning task, and was either positive or negative (Biggs, 1987a). Biggs said that students who liked and were satisfied with their task experienced positive affect while negative affects resulted from students who were required to complete tasks that were beyond their capabilities.

In recent years, research has focused less on illustrating the difference between surface and deep learning (Mahat et al., 2018) and instead placed more emphasis on identifying skills or competencies, called 21st century skills, that students need to succeed in and beyond school (Battelle for Kids, 2019). Chow (2010) contended that in real life, students are not offered multiple-choice question and companies prefer employees who are capable of figuring out solutions to problems and then have the ability share with others how they did it. She further added that in this increasingly complex and dynamic world, graduates need to be able to think critically, find reliable information, and effectively communicate with others. Additionally, global citizens can no longer simply rely on “foundation knowledge and skills such as literacy, mathematics and science” (OECD, 2016, p. 2). Curriculum developers now recognise the importance of developing educational goals and teaching methods that will help them prepare students for college and their future careers (Alismail & McGuire, 2015). In light of these changes, it is imperative that we gain a better understanding of conditions that will enable students to develop skills and dispositions that will help them thrive in this increasingly complex society (Fullan & Langworthy, 2014).

Deep learning and 21st century competencies are important for students to attain academic success (and later professional success), achieve health and relationship skills, and civic engagement (NRC, 2012). The NRC (2012) defined deep learning as the process of developing skills that will allow students to apply learning from one learning area into another learning area or a completely different situation. While other types of learning will enable students “to recall facts, concepts, or procedures”, deep learning will equip them with the ability to apply what they previously learned in solving new problems (NRC, 2012, p 6).

Deep learning will help students acquire a set of interconnected competencies that will help them thrive in this highly complex world and succeed in school as well as in their civic life and future profession (Chow, 2010;

Fullan et al., 2018; Warkentien et al., 2017; William and Flora Hewlett Foundation, 2013). Fullan et al. (2018) opined that as a result of these global changes, having a set of knowledge and accomplishment based on just content will no longer suffice to overcome challenges faced by students and necessitates a new set of competencies.

There are several research groups and individuals who have been investigating deep learning competencies, its impact on students, teachers, and schools. For this study, I focus on two groups, the William and Flora Hewlett Foundation's Deeper Learning Initiative and New Pedagogies for Deep Learning due to the depth and value of their research on deep learning competencies. These two groups have been working with numerous schools, government agencies, and institutions internationally and identified separate lists of deep learning competencies. Although the Deeper Learning Initiative uses the term 'deeper learning' instead of deep learning, however, in this thesis, I use deep learning to avoid confusion.

Competence is "the ability to apply knowledge and skills so that the task at hand is carried out in such a way that it meets the standard of performance required" (Nygaard, Thomas, & Mads, 2008, p. 36-37). Competency is the practical application of an individual's qualification (Nygaard et al., 2008). However, according to the OECD (2005) competencies are not just skills and knowledge; instead, they argued that competencies also include cognitive and practical skills along with several social and behavioural components (i.e. attitudes, emotions, values, and motivations).

The Deeper Learning Initiative (DLI) define deep learning as "a set of competencies students must master in order to develop a keen understanding of academic content and apply their knowledge to problems in the classroom and on the job" (William and Flora Hewlett Foundation, 2013, p.1). They enumerate the following as deep learning competencies: mastery of core academic content, critical-thinking, problem-solving, collaboration, communication, and self-directed learning (Yuan & Le, 2014). They consider deep learning as the kind of learning that will help students with more than achieving high test scores and, therefore, will be more valuable in the long term.

New Pedagogies for Deep Learning (NPDL) calls these competencies 6Cs of deep learning, which include character, citizenship, collaboration, communication, creativity, and critical thinking (Fullan et al., 2018). They also defined deep learning as the process of acquiring these 6Cs. Their competencies transcend ensuring student success in school. I present the two sets of competencies in **Table 3.1.** and include definitions provided by the two groups for each of the competency. Similar competencies were written side-by-side for easier comparison. As can be seen from the table, many of the competencies overlap. Both DLI and NPDL competencies include communication, critical thinking, and collaboration. These three competencies from both groups are also included in the 21st century 4Cs (P21, 2019). NPDL has also included among its competencies, creativity, which is another one of the 4Cs (P21, 2019). These four competencies are thought to be vital in preparing students for more complex life and work in the 21st century (Kay & Greenhill, 2011).

Research commissioned by the William and Flora Hewlett Foundation found that there did not seem to be a common definition of deeper learning shared by various stakeholders that they interviewed (Hattaway Communications, 2017). Furthermore, participants of the study offered varying ways of explaining the concept. It also appeared that different organisation do not have a unified operational definition of the concept. Deep learning has been used to refer to either a process, such as NRC and NPDL's definition, or a set of competencies (Zeiser, Taylor, Rickles, & Garet, 2014). Regardless of whether deep learning is a process or a set of competencies, it is evident that teachers play a critical role in supporting students to develop this in school. In the next section, I elucidate teachers' role in cultivating students' deep learning.

Table 3.1.

Comparison of Deep learning competencies

Deeper Learning Initiative **Deeper Learning Competencies** [a]	**New Pedagogies for Deep Learning** **6Cs of Deep Learning** [b]
EFFECTIVE COMMUNICATION Students demonstrate skills in active listening, clear writing, and persuasive presentation.	COMMUNICATION Communicating effectively with a variety of styles, modes, and tools (including digital tools), tailored for a range of audiences.
CRITICAL THINKING & PROBLEM SOLVING Students apply tools and techniques gleaned from core subjects to formulate and solve problems. These tools include data analysis, statistical reasoning, and scientific inquiry as well as creativity, nonlinear thinking, and persistence.	CRITICAL THINKING Critically evaluating information and arguments, seeing patterns and connections, constructing meaningful knowledge, and applying it in the real world.
SELF-DIRECTED LEARNING Students use teacher feedback to monitor and direct their own learning, both in and out of the classroom.	CHARACTER Learning to deep learn, armed with the essential character traits of grit, tenacity, perseverance, and resilience; and the ability to make learning an integral part of living.
ACADEMIC MINDSET Students develop positive attitudes and beliefs about themselves as learners that increase their academic perseverance and prompt them to engage in productive academic behaviours. Students are committed to seeing work through to completion, meeting their goals, and doing quality work, and thus search for solutions to overcome obstacles.	
COLLABORATION Students cooperate to identify and create solutions to academic, social, vocational, and personal challenges.	COLLABORATION Work interdependently and synergistically in teams with strong interpersonal and team-related skills including effective management of team dynamics and challenges, making substantive decisions together, and learning from and contributing to the learning of others.

CONTENT MASTERY Students develop and draw from a baseline understanding of knowledge in an academic discipline and are able to transfer knowledge to other situations.	
	CREATIVITY Having an 'entrepreneurial eye' for economic and social opportunities, asking the right inquiry questions to generate novel ideas, and leadership to pursue those ideas and turn them into action
	CITIZENSHIP Thinking like global citizens, considering global issues based on a deep understanding of diverse values and worldviews, and with a genuine interest and ability to solve ambiguous and complex real-world problems that impact human and environmental sustainability

Sources: [a] William and Flora Hewlett Foundation. (2013). [b] New Pedagogies for Deep Learning: A Global Partnership (2019).

3.2 Role of teachers in cultivating deep learning

Hattie and Clinton (2011) viewed the role of teachers as activators, change agents, and learning directors. Effective teachers who employ visible teaching and learning can seamlessly shift between teacher-centred teaching and student-centred learning, and from surface to deep learning (Hattie, 2012).

In terms of deep learning, teachers play a crucial role in engendering students to choose this over a surface learning approach. Smith and Colby (2007) posited that teachers must intentionally adopt learning strategies purposely designed to result in deep learning instead of expecting deep learning to occur accidentally. This means structuring lessons, choosing challenging tasks, and providing feedback that encourage the development of deep processing. Furthermore, teachers should reflect on their teaching practice and be critical of resources they are using, the questions they are asking students, assignments they are issuing, as well as their methods for assessing student learning (Smith & Colby, 2007). Holzkamp (as cited in Schrittesser, Gerhartz-Reiter, & Paseka, 2014) argued that teachers have to offer their students good reasons for learning as well as initiate rewarding moments for learning.

"Students have untapped potential but given voice and choice through deep learning we see them influencing dramatic changes to organizations, society, and pedagogy" (Fullan et al., 2018, p. 96). Teachers, emphasised Fullan et al. (2018), have a critical role in cultivating an environment where students have a voice and are offered choices. They reported that in schools that are part of the New Pedagogies for Deep Learning global partnership, they noticed that teachers demonstrated intentionality and precision in selecting pedagogies, co-designed with students, evaluated learning, and maximised use of digital technology in connecting with the world outside of their classrooms. This practice, according to them, resulted in creation of new roles, new relationships, and new learning practices.

Houghton (2004) compiled a list of factors, drawn from works of Ramsden (1992), Entwistle (1988), and Biggs (1999), that teachers may consider to encourage students' deep learning. A few years later, Biggs and Tang (2007) updated Biggs' (1999) original list and released a new summary. I combined these two lists and outlined them in **Table 3.2.** Eight out of nine factors shared the same themes. Both lists emphasised the need to bring out structure of the topic, depth of coverage, correct students' misconceptions, preference for more active learning, more complex type of assessments, scaffolding knowledge, creating a positive atmosphere where students are not afraid of making mistakes, and lastly, making clear intended learning outcomes. However, Houghton (2004) also included a demonstration of teacher's personal interest in the subject among the factors that encourage deep learning.

Table 3.2

Comparison of Deep learning factors

FACTORS THAT ENCOURAGE DEEP LEARNING [a]	**FACTORS THAT ENCOURAGE DEEP LEARNING [b]**
	Showing personal interest in the subject
Teaching in such a way as to explicitly bring out the structure of the topic or subject	Bringing out the structure of the subject
Emphasizing depth of learning, rather than breadth of coverage	Concentrating on and ensuring plenty of time for key concepts
Confronting and eradicating students' misconceptions	Confronting students' misconception
Teaching to elicit an active response from students, e.g. by questioning, presenting problems, rather than teaching to expound information	Engaging students in active learning
Assessing for structure rather than for independent facts	Using assessments that require thought, and requires ideas to be used together
Teaching by building on what students already know	Relating new material to what students already know
Teaching and assessing in a way that encourages a positive working atmosphere, so students can make mistakes and learn from them	Allowing students to make mistakes without penalty and rewarding effort
Using teaching and assessment methods that support the explicit aims and intended outcomes of the course	Being consistent and fair in assessing declared intended learning outcomes, and hence establishing trust

Sources: [a] Biggs & Tang (2007). [b] Houghton (2004).

3.3 Deep learning and the learning environment

Plenty of reports and literature have provided teacher strategies to help students develop deep learning competencies (See Biggs & Tang, 2007; De Monte, & Donehower, 2017; Education Writers Association & William and Flora Hewlett Foundation, 2017; Fullan & Langworthy, 2014; Guerriero, 2017; Huberman, et al., 2014; Lampert, 2015; Mahat, Grocott, & Imms 2017; Mehta & Fine, 2015; National Research Council, 2012; Smith & Colby, 2007; Warburton, 2003). However, these reports rarely focused on the physical features of the learning environments. What kinds of learning environments enabled the application of these strategies? Was it a cellular classroom? Was it indoors or outdoors, or both? What did these places look like? What types of furniture did students and teacher use? What were the different kinds of spatial configurations? What were the digital resources available to students in these learning spaces? These reports lacked details that would be useful for teachers who want to use the learning environment to support their students' deep learning. For example, Martin and McGrath (2015) studied eight innovative public schools in the US that they believed could lead to the transformation of deep learning practices in education. Their report provided a brief profile of each school, followed by a longer write-up describing how the school provided a rich learning environment for its students, cultivated community involvement, and engaged students in self-directed learning.

One of the schools included in the study is Casco Bay High School. The report elaborated on how teachers at the school collaborated to create an output-based curricular unit that integrated several academic subjects. They shared that teachers developed a project that integrated West Virginia's coal mining history with regional music and literature. While the chemistry teacher focused on the carbon cycle and the role of coal in providing energy, the humanities teacher guided students on how to develop policy proposals that provided incentives for other energy sources. This unit culminated in a symposium where students presented their proposal and answered questions from local energy and environmental experts.

The following trimester, they focused on the history, economy and culture of the region. In this unit, students learned how to play Appalachian street music and created a multi-media documentary about West Virginian residents. Students interviewed, photographed, researched, and wrote narratives about their chosen person from the community. As a culminating event, the students played bluegrass music and showed their videos, first at an evening in Portland, then at the Habitat Volunteer Centre in West Virginia, and later via Skype for other members of the community.

That whole section about Casco Bay High School was 365 words. However, none of those was about the physical learning environments used inside and outside the school. Although it is possible to identify the types of facilities these lessons required based on the information authors have provided, these will all, however, remain guesses at best. For instance, when students were researching about alternative sources of energy for the first trimester, did they do these inside their classroom using Wi-Fi-enabled devices? Perhaps this was done in the school library through a combination of books and internet resources. Where in the school premises was the symposium held? Did the lessons on Appalachian music happen inside the school or at the Street Music Community Centre? If it was held in the former, what kind of space, and what additional equipment was used to accommodate this activity? Where did students create their multi-media documentaries? Did the school have a multi-media centre that students used? The list of questions goes on.

Sharing information that answers these questions will provide readers with a better idea on spatial and material requirements for pursuing similar activities. Knowing these requirements in advance may also help teachers identify whether their school can support this kind of endeavour or allow them to consider alternative ways of addressing limitations. Availability of physical space as well as technological and material resources have implications on how teachers plan their lessons and instructions.

A vignette in a white paper written by Fullan et al. (2017) also provided a few examples of how schools across the globe were engaging in deep learning. The vignette offered some descriptions of the physical learning environment—

what were on the walls, types of furniture, and technology used, but almost made invisible the role of the teacher in this environment. Also, elements of the learning environment and how these were used seem to be always reported separately, never together. Again, while it is not impossible to imagine or guess what these spatial and material elements were, lack of details contributes further to the vagueness of how teachers may apply deep learning strategies in conjunction with their learning environment. An excerpt from the vignette is presented below.

> Junior high-school students at High Tech High in California are asked to write, produce, and perform a play based on Euripides' tragedy Trojan Women, adapted to modern day Pakistan. In the process, they dive deeply into the study of democracy, human rights, women's rights, 5th century Athens, and today's Afghanistan, but also develop the technical and moral knowledge and skill that comes from taking responsibility for the whole production of a play, to be performed live for parents and the larger community at the end of the academic year. In another class, students are presented with an overarching idea: Over the centuries, different civilizations have come to be and gone away. They are asked to select any civilization they want and develop a theory that explains why it arose and why it fell. Next, they have to create a physical manifestation of their social theory using a variety of materials including wood, gears, cogs, bands, etc. The materialized theory of each small group will be assembled into a larger mechanical piece to be showcased at the end of the academic year. (Fullan et al., 2017, p. 11)

Where was the physical learning environment in this? What did it look like? Activities were described but not places within which these activities were conducted.

A recently published book by Fullan et al. (2018) provides valuable insights on how deep learning is practiced by the 1200 partners schools from across the globe of New Pedagogies for Deep Learning. The 300 plus page book is described as a comprehensive and practical guide on how to engender school transformations. It was written for policymakers, school leaders, and teachers. More than ten chapters of the book covered topics such as defining and explaining the concept of deep learning, impetus for the need to change the way schools approach student learning, what deep learning looks like in action in various schools and contexts, how a whole-systems change can support schools in adopting these practices, and tasks involved in preparing students for a life in the future that we know will be very different from our current one. The book has a small section on the learning environment, which, according to the authors, is composed of the physical and virtual spaces as well as the cultural and relationship spaces (Fullan et al., 2018). The section on physical space only occupied one and a half pages.

A recent report on the progress of the Deeper Learning Initiative of the William and Flora Foundation for the last ten years found that between 41% and 52% of teachers who were part of the initiative have increased emphasis on various deeper learning competencies in their classroom practice (Warkentien et al., 2017). However, the report did not provide additional details on what these classroom practices looked like nor discussed how the learning environment supported or hindered these practices.

The National Research Council reported that “deeper learning can be supported through teaching practices that create a positive learning community in which students gain content knowledge and also develop intrapersonal and interpersonal competencies” (2012, p. 7). They also recommended increased emphasis on the development of innovative curricular materials that integrate learning across cognitive and non-cognitive domains. Additionally, they proposed increased teacher preparation and professional development that provide active learning opportunities, interaction with colleagues in communities of practice, ongoing work with mentors, and practice-based settings. In response to these findings (along with calls to address teaching practices and materials to support schools and classrooms in meeting higher expectations), the Foundation increased spending on innovative practices and tools for teaching in 2014 and 2015 (NRC, 2012). Contained within the report were descriptions of some teaching practices that encouraged students to direct their learning through collaborative work with fellow students. Although the term 'learning environment' is mentioned 34 times throughout the report (NRC, 2012), these were focused on the sociocultural component of the learning environment. The physical component of the learning environment, again, was largely neglected.

Although a more student-centred teaching approach (Blackmore et al., 2011) was reported to better encourage deep learning in students (Education Writers Association & William and Flora Hewlett Foundation, 2017; Fullan et al., 2017; Huberman, et al., 2014; Huberman, et al., 2016; Lampert, 2015; Mehta & Fine, 2015;), few studies focus on how teachers can successfully adapt their student-centred practices in ways that will maximise potential of Innovative Learning Environments (ILEs)

While recent studies on learning environments indicate positive correlations between ILEs and students' deep learning (Imms, Mahat, Byers, & Murphy, 2017), there remains paucity of research aimed at documenting and understanding how educators utilise the learning environment to support students' deep learning. The Innovative Learning Environment and Teacher Change (ILETC) Project, in which this research is situated, is helping to change that by exploring how teachers understand and practice the deep learning concept, measuring students' surface and deep learning approaches to learning, and investigating spatial implications of different teaching practices (Imms et al., 2017).

To be clear, this is not a criticism of the value of any of the research, reports, and publications mentioned above. Rather, it is a demonstration of my point that there is little literature or studies on deep learning and the learning environment. Teachers have expressed desire to receive more information on the kinds of practices that support deep learning competencies and how they can apply these in their classrooms (Hattaway Communications, 2018) but paucity for rich descriptions of deep learning practices is one of many barriers preventing teachers from adapting deep learning practices and drive them to revert to traditional teaching approaches (Mehta & Fine, 2015). This research aims to address this gap by investigating strategies that maximise features of the learning environment employed by museum educators.

3.4 Summary

In this chapter, I engaged with literature centred on deep learning. I started by tracing its history and identified researchers who have significantly contributed to its development. I also explored how teachers can support students in developing deep learning competencies. And finally, I investigated possibilities for teachers to use the learning environment to facilitate students' deep learning. A gap that was identified through the literature review is the lack of rich descriptions on strategies that utilise the learning environment to promote students deep learning. To address this gap, I will be exploring practices of museum educators. In the next chapter, I will advance the theoretical framework, Contextual Model of Learning (Falk & Dierking, 2000, 2013) to inform collection and analysis of data for this research.

CHAPTER 4: THE CONCEPTUAL FRAMEWORK

The literature review in the previous chapters provided an overview of the museum education field, with a particular focus on programs for student groups. I also traced the historical development of deep learning and began to explore the idea of teachers as curators of their learning environment. In this chapter, I focus on the conceptual framework that underpinned this research study. Dewey (1938) defined conceptual framework as the intersection of theory and practice. In the context of this research, I employed Falk & Dierking's (2000, 2013) Contextual Model of Learning to guide the identification of appropriate questions, research methods, and analyses of this research.

In the succeeding sections, I consider the development of the Contextual Model of Learning and subsequently discuss how it was applied in investigating other studies. I also articulate how Falk and Dierking's influential theory shaped the direction of my study.

4.1. The Contextual Model of Learning

In 1992, Falk and Dierking published *The Museum Experience* and introduced the Interactive Experience Model as a lens through which they examined museum visits and experience (Falk & Dierking, 1992). They also used the Interactive Experience Model as a framework to assist them with organising and interpreting relevant museum research, information, and literature drawn from the fields of psychology, anthropology, and sociology (Phipps, 2010; Rennie, 2016). The book was a significant milestone in understanding museum learning (Rennie, 2016) and remains influential in many succeeding research on this subject matter (Phipps, 2010). It offered a departure from much of the scholarly work on museums, particularly on science centres, during a period when studies were predominantly atheoretical, programmatically focused, and lacked an operational definition of learning (Phipps, 2010). In investigating museums, many researchers applied assessments similar to those used in schools that leaned towards recall of facts to measure learning (Fisher, 1997).

However, according to Phipps (2010), the mid-1990s saw a period of rapid transition in the field of informal science learning, under which science centres and museum are included. One of the impetus for this change, Phipps added, was the conference of Public Institutions for Private Learning (PIPL) in 1994. The primary objective of the conference was to initiate the development of "a manageable list of learning outcomes that could result from a museum visit that could be used in formulating research questions to investigate learning in museums" (Falk, Dierking, et al., 1995). During the conference, leading learning researchers from a wide range of theoretical standpoints (including constructivism and socioculturalism) as well as experts on themes around human memory, motivation, and physical factors that impact learning lent their perspectives on museum learning (Falk, Dierking et al., 1995).

Phipps (2010) opined that a significant outcome from the conference was the recommendation from PIPL to focus research on learning as both a process and a product, from which to examine the place of museum learning in people's lives, establish effective exhibit design principles, and place an emphasis on hypothesis generation and testing. She also said that attendees of the conference collectively agreed that museum researchers move beyond using fact recall as a measure of museum learning and find more suitable ways to document museum learning. She added that the PIPL conference, and subsequent publications, led to a critical shift in the focus of articles being published from being more evaluation-centric articles to having a greater research focus. She clarified that while evaluation sought to inform use of particular museum programs or exhibitions, research, on the contrary, "examines a particular learning situation with an eye toward advancing the field with the knowledge that is applicable in a broader range of situations" (Phipps, 2010, p. 6).

The PIPL conference was held at the Institute for Learning Innovation in Annapolis, Maryland in 1994. John Falk founded the Institute for Learning Innovation and became its inaugural Director in 1986 (Rennie, 2016). The Institute was a research and development not-for-profit driven by its primary objective of pursuing initiatives to help understand and support free-choice learning (Rennie, 2016). In 1993, Lynn Dierking joined the Institute as Associate

Director. This move strengthened the flourishing partnership between Falk and Dierking, which began with their first joint publication, *The Museum Experience* (Rennie, 2016).

Falk and Dierking's (1992) introduction of the Interactive Experience Model, as a framework, made explicit the significance of three interacting contexts (personal, social, and physical) in the experience of visitors to museums and related places. Producing this book was not without its challenges. First, they had issues finding other relevant empirical studies to add to their own previously published individual and joint research on museum learning (see: Falk, 1983, 1997a, 1997b; Falk & Balling, 1982; Falk, Koran, Dierking, & Dreblow, 1985; Falk, Koran, & Dierking, 1986; Falk, Martin, & Balling, 1978; Koran et al., 1983; Koran & Dierking-Shafer, 1982). Second, difficulty finding a publisher delayed the book's publication by five years (Rennie, 2016).

Eight years later, Falk and Dierking (2000) renamed their framework as the Contextual Model of Learning in another jointly written book, *Learning from Museums: Visitor Experiences and the Making of Meaning*. This new and expanded framework differs from the previous one in three noteworthy ways. First, instead of being about the general experience of visiting museums, it became more focused on learning in museums (Rennie, 2016). Second, while the two contexts, personal and physical, remained unchanged, the cultural dimension was embedded as part of the sociocultural context. The cultural dimension in this context referred to largescale influences of cultural value bestowed upon learning from museums as well as the cultural context of the museum within society (Falk and Dierking, 2008). They argued that learning "filtered through the personal context, mediated by the sociocultural context, and embedded within the physical context" (Falk & Dierking, 2013, p. 30). The third change added a temporal aspect encompassing the three contexts. Falk and Dierking (2013) explained that learning involves never-ending interaction and integration of the three contexts over time to make meaning, "perhaps the best way to think of it is to view the personal context as moving through time; as it travels, it is constantly reshaped as it experiences events within the physical context, all of which are mediated by and through the sociocultural context" (p. 11).

Falk and Dierking (2013) added that the personal context took into account what visitors bring with them during their museum visit (Charitonos, 2015) and "represents the sum total of personal and genetic history that an individual carry with him/her into a meaning making situation" (Falk & Dierking, 2008, p.21). In this context, learning in museums is characterised as a very personal experience that is dependent on several factors such as motivation and expectations; prior knowledge, interest, and beliefs; and choice and control. They also recognised that although personal motivation and emotional cues prompted learning, these were still facilitated by personal interests. They surmised that while the decision to visit museums may not have been intrinsically motivated, it was visitors' personal interests that dictated paths they followed in viewing the exhibition and specific objects they chose to examine. They also contended that visitors' prior knowledge was crucial to learning. Visitors' potential for learning increases because their prior knowledge about certain concepts is reinforced by additional information and experience in the museum (Falk & Dierking, 2013).

Falk and Dierking (2000, 2013) view the museum visit as a social activity. While the personal context explained visitors' individualistic inclinations regarding learning, the sociocultural context, on the other hand, emphasised how people learn together in museums (Lundgren & Kippen, 2019). They added that in the sociocultural context, learning is positioned as both an individual and group experience. In both the Contextual Model of Learning (Falk & Dierking, 2000, 2013) and Constructivism (Vygotsky, 1978), learning is seen as socially mediated. Individuals do not learn in isolation. Instead, learning is a shared process between a community of learners where each one contributes to individual knowledge and prior experiences (Falk & Dierking, 2000, 2013). Therefore, the potential for learning becomes more potent when people visit museums with their family or friends and when students go to museums with their classmates.

In the physical context, learning is activated through the individual's interaction with the physical world (Falk and Dierking, 1992; 2013). Meaning making is influenced by visitors' reactions to the physical environment of the museum—the built environment, architecture and "feel" of a building, as well as objects contained in it (Falk & Dierking 2000, p57). Sights, sounds, odours, and sensations all contribute to the museum learning experience. Also included in the physical context are objects that visitors encounter in a museum, including exhibition design features (i.e. layout, sequence, and labels). Additionally, studies have found that architectural design aspects of the museum (i.e. lighting, crowding, colour, sound, and space) also have a subtle impact on visitor learning (Coe, 1985; Hedges, 1995; Ogden, Lindburg, & Maple, 1993). They further added that the museum experience is gestalt—it starts when people make the decision to visit a museum, includes their travel to the museum, continues as they visit different galleries, converse with other people, eat, and even when they purchase items from the museum shop. The museum experience extends to post-visit discussions when certain words, images, events, or objects that visitors see outside the museum trigger memories from their museum trip (Falk & Dierking, 2013). Matusov and Roggoff (1995) concurred by saying that museum learning begins before and continues after the physical visit to a museum.

The Contextual Model of Learning provides an over-arching framework to organise information on learning, including the numerous details that sit within. Falk and Dierking (2000) speculated that thousands of factors, directly and indirectly, impact learning from and in museums. After evaluating findings from hundreds of studies, they identified eight suites of factors that are fundamental to museum learning. These eight key factors include:

Personal Context

1. Motivation and expectations
2. Prior knowledge, interests, and beliefs
3. Choice and control

Sociocultural Context

4. Within-group sociocultural mediation
5. Facilitated mediation by others

Physical Context

6. Advance organisers and orientation
7. Design
8. Reinforcing events and experiences outside the museum

These factors were later amended to include prior experiences under the personal context as well as orientation to the physical space and architecture and large-scale environment (Falk & Storksdieck, 2005). They separated prior knowledge and interest but removed prior belief. This brought the key factors to a total of 12 as enumerated below:

Personal context

1. Visit motivation and expectations
2. Prior knowledge
3. Prior experiences
4. Prior interests
5. Choice and control

Sociocultural context

6. Within-group social mediation
7. Mediation by others outside the immediate social group

Physical context

8. Advance organisers
9. Orientation to the physical space
10. Architecture and large-scale environment
11. Design and exposure to exhibits and programs
12. Subsequent reinforcing events and experiences outside the museum

There was evidence to suggest that each of these factors influenced learning (Falk & Storksdieck, 2005). However, they clarified that they did not find the extent to which each of these factors contributes to learning outcomes, in what ways, and for whom. Moreover, they were unable to identify one or two factors as more important than others. This, they said, was because none of the factors was studied in isolation and as a result little is known about combined effect of these factors or individual significance of each (Falk & Storksdieck, 2005). To address this gap, Falk and Storksdieck (2005) embarked on an investigation involving a random sample of 217 adult visitors of the California Science Centre. Additionally, they also wanted to test whether the Contextual Model of Learning was a useful framework for understanding learning from museums.

Findings from the study confirmed that, at least for this particular group, several factors including prior knowledge, motivation, and expectations within-group social interaction, advance organisers, and exhibition design had significant impact on visitor learning. On the other hand, prior experience, prior interest, choice and control, between-group social interaction, orientation and architecture also influenced learning, but not as strong as the factors stated earlier. They did admit that a possible weakness of the study may be their limited ability to validly and reliably measure effects of the factors, a challenging task, they said. They countered that despite that, findings show that numerous factors were essential but that no single factor could adequately explain learning outcomes across all visitors. This underscores the complexity of learning from museums and that simple, reductionist, linear approaches to understanding learning from museums are insufficient.

4.2 Applying the Contextual Model of Learning as a research framework

The significant contribution of the Contextual Model of Learning to educational research is in offering a structure to account for all relevant factors in planning for research as well as in providing a way to organise and analyse data, and subsequently report findings (Rennie, 2016; Riegel & Kinderman, 2016). According to Harms & Krombaβ (as cited in Riegel & Kinderman, 2016), the Contextual Model of Learning is not a predictive framework. It is a descriptive framework that is not concerned with predicting learning effects of visiting museums. It is useful in conceptualising studies that investigate these effects (Riegel &

Kinderman, 2016). Wilde (2007) similarly reviewed the framework and argued that it is not a reductionist explanatory model for the learning processes but a way of framing thinking about learning.

The Contextual Model of Learning was very influential. This was evident in an investigation of research trends and findings on science education and free-choice-science learning drawn from articles published in three key science education journals from 1997 to 2007. From these 85 studies, 14 reportedly used the Contextual Model of Learning as the framework (Phipps, 2010). Additionally, their first two books (*The Museum Experience* and *Learning from Museums: Visitor Experiences and the Making of Meaning,* and subsequent editions) have been cited over 6000 times. *The Museum Experience* (Falk & Dierking, 1992) have been translated into Chinese and Japanese (Rennie, 2016).

Falk and Dierking's framework continues to be used as a framework in empirical studies that investigated learning in museums (Eckes, Groβmann, Wilde, 2018; Holliday, Lederman, & Lederman, 2014; Hsu & Liang, 2016; Hsu, Liang, Chiou, & Tseng, 2018; Hou, Wu, Lin, Sung, Lin, & Chang, 2014; Kisiel, 2003; Lundgren & Crippen, 2019; Riegel & Kinderman, 2016; Wilde, 2007) and schools (Dunlop, Clarke, McKelvey-Martin, 2019; Roseler & Dentzau, 2017). Studies situated in museums tend to be science-centric such that most of the settings for these studies were in science centres or museums. However, it was also used as a framework for other settings such as performing and visual art venues (Manning, Verenikina, & Brown, 2010), professional and scientific meetings or conferences (Chandler, Anstey, Munro, and Morrison-Beedy, 2013), church (Riegel & Kindermann, 2015), and communities in close proximity to mines (Ramirez-Andreotta, Brody, Lathrop, Loh, Beamer, & Brown, 2016).

All these studies focused on learning and one other aspect of learning. A few examples include learning and social media (Lundgren & Crippen, 2019), adult learning (Manning et al., 2010), environmental health and justice (Ramirez-Andreotta et al., 2016), blended mobile learning (Hsu & Liang, 2017), game-based mobile learning (Hsu et al., 2018), and biology education (Wilde, 2007). Literature seems to have a balanced distribution of the type of participants between adults and children. However, it seems that museum educational researchers who used the Contextual Model of Learning exhibit a proclivity to focus on learners and their meaning making. Far too little attention is given to investigations on how mediators of learning, such as museum educators, can better support learner's process of meaning making. As far as reviews of literature, the Contextual Model of Learning has not yet been applied to studies that explore museum educators' use of learning environment to encourage student's deep learning.

4.2.1 Critique of the Contextual Model of Learning as a research framework

A critique of the Contextual Model of Learning expressed by Achiam (2015) is that due to its strong influence on researchers, it may inadvertently generate a selective uptake of ideas about out-of-school science education, particularly those in museums. While Achiam (2015) strongly concurred that museums should be visitor-centred, she cautioned that uncritical uptake of the Contextual Model of Learning " (p. 2) as a comprehensive model of what takes place during museum visits" may lead museum staff to accept that they have minimal influence over what goes on during a museum visit since their "carefully designed education programs or exhibitions have little or no impact on visitors' learning outcomes" (p. 2).

Achiam (2015) explained that it appeared that the model may be inadvertently promoting the idea that the visitor's experiences are divorced from the museum's interpretative efforts. She added that other unintended outcome may be that the framework's general nature fails to take into account the content of what is being learned or experienced. According to her, museums should keep in mind that in any scientific encounter, there are relevant trajectories of inquiry that can be pursued. It is then the responsibility of the museum, or specifically the designers of the exhibitions, to make these productive trajectories explicit. Researchers, on the other hand, are asked to keep in mind the following: 1) the inclusion of the content is a crucial part of the museum experience and should explicitly address the interpretative responsibility of museums, and 2) explicitly focus on how science is experienced by visitors (Achiam, 2015).

Walker (2010) also criticised the Contextual Model of Learning for not accounting for the concept of mediation through curators or other individuals. I, however, argue that mediation by other people has been adequately addressed by the two factors included under the sociocultural context. Falk and Storksdieck (2005) listed mediation within the group and mediation by others outside the immediate group as key factors that influence museum learning.

Despite these criticisms, the Contextual Model of Learning can still provide a solid empirical and contemporary structure for understanding how museum educators utilise the learning environment to set up conditions that will help students develop their deep learning competencies. Its value, specifically for this research, lies in its nature as a descriptive framework and as a way for me to organise and analyse data, and subsequently report findings on strategies using the learning environment employed by museum educators to support students' deep learning (Rennie, 2016; Riegel & Kinderman, 2016).

Although the Contextual Model of Learning is not a framework for understanding teaching in museums, I am using it as a lens through which to investigate how museum educators facilitate students' deep learning in museums. In the context of this research, the Contextual Model of Learning serves two objectives. First, it offers a conceptual framework to understand specific conditions in which museum educators use the learning environment to promote student deep learning. Second, it helps to organise my study on practices of museum educators in relation to learning in museums.

In an effort to establish theoretical grounding for museum's educational practices, Kari Ross Nelson (2015) applied Professor David Merrill's instructional design principles on three texts from Museum-Ed's[5] Top Ten book list of required

---

[5] Museum-Ed is a non-profit borne out of museum educators' expressed desire to have a network for easy exchange of information. The organisation provides tools and resources by and for the museum education community. It is a virtual community where museum educators from

reading for teaching and learning in museums. Merrill (2002) is an emeritus professor of Instructional Design at Utah State University who, in his seminal article, *First Principles of Instruction*, consolidated a body of literature into five principles for designing successful instructions. These five principles are (1) learning is promoted when learners are engaged in solving real-world problems; (2) learning is promoted when existing knowledge is activated as a foundation for new knowledge; (3) learning is promoted when new knowledge is demonstrated to the learner; (4) learning is promoted when new knowledge is applied by the learner; and (5) learning is promoted when new knowledge is integrated into the learner's world (Merrill, 2002). After being field-tested and applied in empirical studies from a wide variety of settings, including corporate contexts, blended formal and informal settings, it has become a well-accepted and employed text in the field of instructional design (Nelson, 2015).

One of the texts that Nelson evaluated was Falk and Dierking's (2013) *The Museum Experience Revisited*. In general, Nelson (2015) found that the Five Principles can be applied in the context of museum education as a way to optimise learning. She argued that some of the principles appeared to spontaneously occur in museum learning, particularly principles two and three. She concluded that museum educators would definitely benefit from integrating each of the five principles into their interpretation strategies. I describe below how *The Museum Experience Revisited* (Falk & Dierking, 2013) measures against Merrill's principles.

Principle 1: Learning is promoted when learners are engaged in solving real-world problems

Nelson (2015) believed that among the three books evaluated, this principle is most strongly represented in Falk and Dierking's (2013) book since museums implicitly fulfil this. In museums, visitors seek experiences that are

---

the US and overseas (and anyone interested in museum education), may ask questions and immediately pursue solutions, exchange ideas, explore current issues, share resources, think about their work, and find inspiration for new directions.

specific to their identity-related needs or personal and cultural contexts. This, she argued, has a powerful potential to impact learning. Using the Contextual Model of Learning as a framework to view the museum from a visitor's perspective helps museum educators recognise and support visitor motivations and needs (their real-world problems). She also mentioned some of the initiatives pursued by museums such as saving wildlife and the environment as connecting the museum visitors real-world problems.

One example of this is a training program for improving medical students' visual diagnostic skills at the Boston Museum of Fine Arts where 24 pre-clinical students participated (Naghshineh et al., 2008). They found that teaching participants visual arts observation techniques improved their capacity to make accurate observations in both artistic and clinical imagery, which they concluded can play a role in developing medical students' accuracy in conducting medical observations. In the context of this research, this principle can be applied by museum educators when they create opportunities for students to identify, explore, and solve, hypothetically or otherwise, real-world problems.

Principle 2: Learning is promoted when existing knowledge is activated as a foundation for new knowledge

In her analysis, Nelson (2015) concluded that there is strong evidence of this principle in museum learning. The Contextual Model of Learning recognises the importance of prior knowledge in learning. In fact, prior knowledge is one of the 12 key factors that Falk and Dierking (2000) have identified.

Many museums identify curriculum links between their school programs and state or national curriculum standards (see: websites of National Museum Australia, Museums Victoria, and Museum of Chinese Australian History for examples). In this study, museum educators can apply this principle by gauging existing knowledge of students and building on this with the introduction of relevant information.

Principle 3: Learning is promoted when new knowledge is demonstrated to the learner

This principle highlights the importance of showing instead of telling. Nelson (2015) found that this principle was fulfilled in museums through interactions with museum staff who demonstrate new knowledge to students. Museum staff also facilitate student learning through performances, guided table activities, and even in informal conversations in the exhibition galleries.

In one particular study, 18 students participated in museum activities about buoyancy, bubbles, and water current. This activity was facilitated by museum staff and indicated increased content knowledge on some of the concepts being studied (Tenenbaum, Rappolt-Schlichtmann, & Zanger, 2004). These activities involved a museum educator showing, instead of telling, the students about the science concepts they were learning. The museum educator can apply this principle by utilising the experiential nature of museum learning. In facilitating student programs, the facilitators can model or demonstrate a skill or process, most especially complicated ones, before inviting students to try for themselves.

Principle 4: Learning is promoted when new knowledge is applied by the learner

Availability of materials for hands-on activities or exploration in museum's exhibition galleries and opportunity to work together with peers support this principle (Nelson 2015). This is emphasised in Falk and Dierking's (2000) text when they said that visitors read interpretive materials but pay more attention to exhibition objects and interactive components (Nelson, 2015).

Many museums offer hands-on activities as part of their school programs. These hands-on activities require students to apply recently acquired concepts or knowledge as part of an activity. A study involving 50 students undertaken to investigate outcomes of class visits to natural history museums confirmed that the concrete experience offered by the museums helped students better understand scientific ideas and concepts (Bamberger & Tal, 2008). In the context of this study, a museum educator may apply this principle by creating opportunities for students to apply recently acquired skills or knowledge in creating an output. This output may be in the form of an artwork, presentation, or other forms of demonstration.

Principle 5: Learning is promoted when new knowledge is integrated into the learner's world

This principle underscored the importance of the relevance of what the student is studying with what is happening in the world outside the classroom. According to Nelson (2015), Falk and Dierking's work support this principle by advocating for museum staff to find connections between the museum content and students' personal lives. She added that this connection might happen when students create their own works of arts or exhibitions from their personal collections.

To a certain degree, this principle is closely related to Principle #1, which bridges what students are learning in the museum with what is happening outside of this setting, and specifically for this principle, their personal lives. A museum educator may apply this principle by selecting objects for the activity with which students are familiar. Alternatively, the museum educator can also choose to draw concrete examples from themes that are relevant to the age, gender, cultural background, or socio-economic status of students.

In the next section, I elucidate how the Contextual Model of Learning has been reified in the current study.

4.2.2 The Contextual Model of Learning as a framework to investigate museum educator practice

Although the Contextual Model of Learning is a framework originally developed for understanding visitor learning in museums, it is a viable conceptual framework for examining museum educators' practice based on the reasons outlined above. Additionally, this framework provides a structure to empirically identify relationships between interconnected contexts that influence museum educators' practice.

Similar to students, the personal, sociocultural, physical are interconnected contexts that also inform museum educators' behaviour. However, in investigating teaching through the lens of student learning, only eight out of the 12 factors that Falk and Storksdieck (2005) have identified remain relevant. I elaborate on these eight factors below.

Physical context

Two factors influence museum educators' use of the learning environment for teaching: (1) orientation to the physical space; (2) architecture and large-scale environment; and (3) Design and exposure to exhibits and programs. The physical context of the museum may include but are not limited to, "large-scale properties of space, lighting, and climate, as well as microscale aspects such as the exhibitions and specific objects contained within them" (Falk & Dierking, 2008, p. 22). Specifically, the physical context includes the learning environment that museum educators use to teach student groups. In Chapter 2, I identified features of museums that educators have used in facilitating museum education programs. These include features, which I call elements, that have physical forms (i.e. as artworks, artefacts, specimens, teaching materials, etc.) as well as those that do not have physical manifestations (temperature, sound, light, etc.). I chose to use the term 'element' because, as demonstrated by literature, what museum educators use for teaching (i.e. as sensory stimulus such as sound and smell or spatial organisation) were beyond materials that could be touched.
The physical factors influence how museum educators use the learning environment. In this study, I reified the physical context as elements that museum educators use for teaching.

Personal context

Under the personal context, four factors remain relevant: (4) prior knowledge; (5) prior experience; (6) prior interests; (7) choice and control. These factors influence how museum educators use the elements of the learning environment for teaching. In Chapter 2, I elucidated Gibson's (1979) theory of affordances. In the context of this study, affordance is reified as functions of the elements in the teaching and learning process. For example, an object such as a painting may be used to promote visual engagement or create an authentic encounter with a real object. The affordances that a museum educator sees and uses are a result of their prior knowledge and experience about the painting or how to use paintings for teaching. Their prior interest may also inform their decision to use that particular painting over another painting or a different element altogether. As pointed out by Howe (1984), "each person's experiences of an environment are unique and constantly subject to variation, largely because people learn from their own experiences. Many factors connected with individual development and learning, including perceptual sensitivity, personality and temperament, combine together to ensure that however uniform an environment might appear to be, people's actual experiences differ very considerably" (p. 96). Lastly, the level of choice and control when implementing museum education programs may also inform how museum educators use elements.

Sociocultural context

Since I am investigating students who are experiencing the museum as part of a group, usually during a field trip, the relevant factor for this is (8) social mediation within the group. This context focuses on how the museum educators mediate the learning within the student group, and this may include museum educator-student and student-student interactions. The sociocultural context is reified in this study through the strategies that museum educators use to support students' learning, specifically deep learning.

Due to the highly complex nature of learning in museums and other museum-like settings (Falk & Storksdieck, 2005), it follows that facilitating student learning in museums is also equally complex. Selecting and prioritising only these eight factors do not minimise the significance of other factors that influence teaching. For example, it is highly possible that, in the sociocultural context, mediation by others outside the groups' social group may still happen and this, too, will contribute to a more enriched museum experience. Other factors, even those that have not been identified by the Falk and Storksdieck (2005) also affect the way museum educators facilitate student programs in the museum. The Contextual Model of Learning provides a scope for the amount and types of learning that multitude of studies have already conducted around this topic (Falk & Storksdieck, 2005). They also acknowledged that random events before, during, and after the visit, all contribute to students' learning.

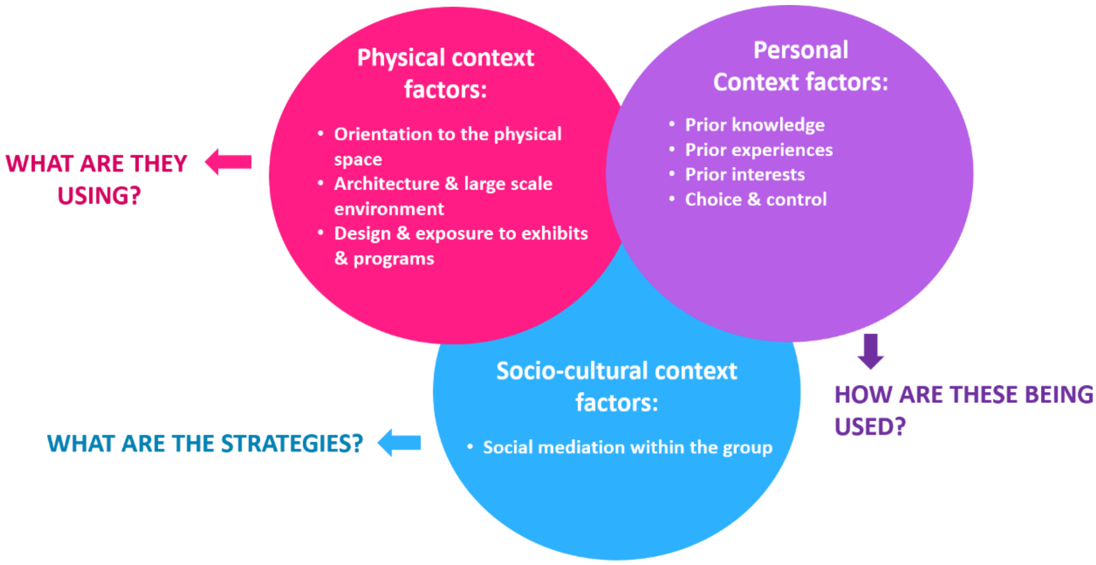


Figure 4.1 The Contextual Model of Learning reified in this study

The factors that I have identified (as depicted in Figure 4.1) are those that are, to a degree, within the control of the museum educator. Examples of random events that museum educators have some control over include omitting certain exhibit items usually included in the program due to too many people in the gallery or that students have a higher level of knowledge individual on the topic being explored. These events may or may not happen, but if they do, are not within the control of the museum educator and can influence how the museum educator conducts the program.

4.3 Summary

In this chapter, I mapped out the museum educator's practices in facilitating programs for student groups using Falk and Dierking's (2000, 2013) Contextual Model of Learning. The fundamental assumption of the conceptual framework is that learning in museums is influenced by the interplay of three contexts: physical, personal, and sociocultural. I explained how I applied their framework to investigate teaching practices of museum educators in museums, specifically those that are relevant to student groups. The framework also provides a structure to guide analysis of case studies in this study. In the following chapter, I will discuss the research design and methods.

CHAPTER 5: RESEARCH DESIGN AND METHODS

The previous chapters provided literature reviews to set the context for this study and presented the conceptual framework that guided the collection and analysis of data. In this chapter, I focus on the research design and methodological decisions undertaken during the study to answer the research questions. In the succeeding section, I detail the case study approach used, followed by how sites and participants were selected and recruited, and finally, how I collected and analysed data.

5.1 Research design

This study aims to investigate strategies that museum educators use to maximise features of the learning environment that facilitate students' deep learning and, subsequently, to explore how school teachers can apply these strategies in their classroom practice. Due to the complex nature of student learning in museums, a case study approach was selected. This allowed for the collection of rich data, which captured the complexity and detail of the construct under investigation. Stake (1995) argued that using case study demonstrates the researcher's commitment to study the complexity of a particular situation by viewing it from multiple angles in order to build a full picture as possible. I determined that using the case study approach and applying the Contextual Model of Learning (Falk & Dierking, 2000, 2005) as a conceptual framework is apropos for investigating museum educators' relevant practices around the use of the learning environment for students' deep learning. The question that guided this investigation was:

> How do museum educators maximise the use of their learning environment to facilitate students' deep learning?

In the following section, I describe the case study approach used in this study. Within it, I discuss selection of participating institutions and individual participants, methods adopted for collecting data, and other methodological considerations.

5.1.1 Case Study Approach

World view and bias of researchers are present in all social research (Fields & Kafai, 2009). My 20-year experience working in museums and involvement in various aspects of museum education, articulated in Chapter 1, informed the design and conduct of this research. My personal background also influenced my views on teaching and learning. Recognising and acknowledging my own personal world view puts me in a better position to see, hear, and interpret the behaviours of the research participants (Dibley, 2011; Fields & Kafai, 2009). My constructivist position about teaching directed me to pursue a qualitative approach in accomplishing a rigorously constructed first-hand investigation of the phenomena. I was interested in "what people say and do, and why" (O'Toole & Beckett, 2010, p.28). To understand the complex nature of museum educators' teaching student groups, I used the case study approach.

A case study is defined as the study of "the singular, the particular, the unique" (Simons, 2009, p. 3) of an individual case that is bound by a system (Smith, 1978). What can be considered as a case includes a person, a group of people, a classroom, a program, or a teaching context within which a phenomenon is examined (O'Toole & Beckett, 2010; Simons, 2009). In addition, Creswell (2017) emphasised that a case may also focus on a concept of a phenomenon under investigation, instead of the context, and defined case study as "the study of an issue explored through one or more cases within a bounded system" (p. 73).

Similar to Creswell, Yin (2009) defined a case study is an empirical inquiry investigating a "contemporary phenomenon in depth within its real-life context" (p. 18). Case studies are helpful for discovering situations that are little known or understood, where the context is not easy to disentangle from the phenomenon under investigation (Yin, 2003). As pointed out in the previous chapters, and as emphasised by Falk and Dierking (1992, 2000), teaching and learning in a museum is highly influenced by the physical context. My research is primarily concerned with how museum educators use the learning environment to facilitate student's deep learning, which cannot be extricated from the context;

this aligns with Creswell's (2007) view. The phenomenon I investigated is museum educators' use of the learning environment to facilitate students' deep learning.

I chose the multiple-case study design because it allowed investigation of the same research questions in different settings while applying similar data collection and analysis in each setting (Herriott & Firestone, 1983). To provide robust evidence, I selected three cases. One case is a group of museum educators teaching in museums, the second case is a group of school teachers teaching in museums, and the last case is a group of non-school teachers, predominantly museum educators, teaching in school classrooms or non-museum venues (**Figure 5.1**). To clarify, while the cases appear to be location-bound (museum, school), I investigated a phenomenon instead of sites.

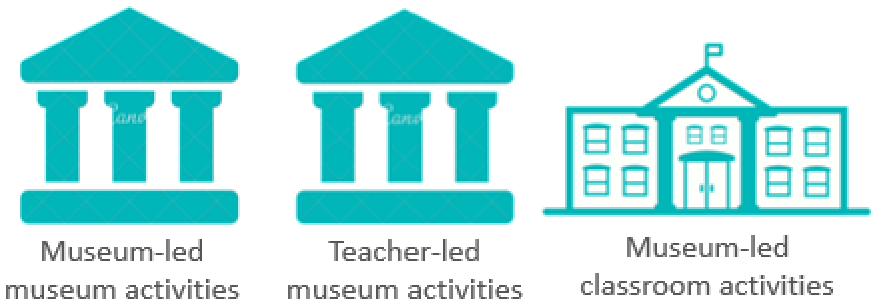


Figure 5.1 Three case studies

Adopting a multiple-case study approach was suitable for this research due to several reasons. First, according to Willis (2007), case studies are "about real people and real situations … [and] illuminate the reader's understanding of the phenomenon under study" (p. 239). Second, case studies allow researchers to have close and direct personal contact with organisations and people being examined (Andreas, 2003). Third, it enables the researcher to "gather rich, detailed data in an authentic setting" (Willis, 2007, p. 240). Fourth, it is this richness of comparative data that allows for complex analysis and multi-layered understanding of the phenomenon being studied (Yin, 2009). This study is an investigation of museum educators teaching school groups in museums and in schools and school teachers teaching students in museums. The opportunity to directly observe museum educators and school teachers as they went about their usual practice of teaching students in a museum or a school, versus a staged or controlled setting, was critical to this study.

5.1.2 Site Selection

A different set of selection criteria was applied to each case study. Sites are where the teaching activities were conducted by participants, where the phenomenon investigated was happening. To understand how museum educators teach student groups, I needed to study them where they taught students. Therefore, there were two types of potential sites:

1. Museums where museum educators conduct education programs for school groups (Case Study 1: Museum educator-led Excursions into museums) or where school teachers bring their students for a field trip and conduct self-guided museum activities (Case Study 3: School teacher-led Excursions into museums).
2. Schools or other venues where museum educators go to conduct museum education programs for school groups (Case Study 2: Museum educator-led incursions into schools).

For this study, the term ‘museum’ encompasses public museum, public gallery, or historic shrine in Australia or New Zealand and include art, history, and cultural history museums or science centres. The research methods I used for each case study are summarised in **Table 5.1.** I developed a site selection protocol prior to contacting potential participating institutions.

Table 5.1

Research Methods

Case	Site	Participants	Participants per site	Activity type	Activity duration	Participation strategy
1	Museum	Museum educator	1-5	Observation and semi-structured interviews	1-3 sessions per participant with 1-3 hours per session (depends on duration of program)	Purposive sampling and snowball sampling
2	School	Museum educator	1-5	Observation and semi-structured interviews	1-5 sessions per participant with 1-3 hours per session (depends on duration of program)	Purposive sampling
3	Museum	School teacher	1-2	Observation and semi-structured interviews	1-2 sessions per participant with 1-3 hours per session (depends on duration of program)	Purposive sampling from results of Phase 1 of ILETC project survey (Imms et al., 2017)

In the subsequent sections, I describe in detail how sites were selected and recruited for each of the three case studies.

Case study 1: Museum educator-led excursion into museums

Museums are a popular venue for educational school field trips. According to the Council of Australasian Museum Director (CAMD) (2015), 23 million students accompanied by their teachers participated in school group visits to CAMD member museums over the last decade. This number is very conservative as the figure only report statistics collected from CAMD member museums, which are only 62 institutions. There are already 1184 museums operating across Australia by the end of June 2008 (CAMD, 2009). This means that visitor numbers from more 1,000 museums are not included in the 23 million.

The diversity of on-site school programs offered by museums may be broadly organised into three types: (a) self-guided, (b) museum guided, and (c) digital outreach. The first type, self-guided visits, happens when students go to the museum together as a group then explore the museum on their own, with their teacher, or with the help of other educators who are not affiliated with the museum. The second type, museum guided school programs, are structured activities facilitated by museum staff or volunteers that school groups participate in during their museum visit. When museums use digital technology to facilitate lessons for groups of students who are not physically in the museum, these programs fall under the third type, digital outreach. The excursion into museums case study focuses on the second type, programs for school groups conducted within the museum by a museum staff.

Purposive sampling (Biernacki & Waldorf, 1981) and snowball sampling (Kerlinger, 1986; Patton, 2002) were utilised for Case Study 1. Purposive sampling refers to the selection of cases through the use of judgement. Cases are selected with a deliberate effort to include presumably typical groups in the sample or when there is a limited number of people that have expertise in the topic being investigated (Kerlinger, 1986). Snowball sampling, sometimes referred to as chain referral sampling is a method that relies on identifying sample through referrals made by people who share or know of others who possess specific characteristics relevant to the study (Biernacki & Waldorf, 1981). This case study focused on investigating how museum educators used spaces and objects within the museums' premises in conducting education programs for school groups. Employing purposive and snowball sampling ensured that the aim to document what and how museum educators used different elements of the learning environment in tandem with deep learning strategies to facilitate students' deep learning was accomplished. Target participants for this case study were museum educators. In the context of this study, museum educators are staff members who actively and purposely facilitate the learning experience of students during their museum visit and may include, but are not limited to, museum education staff, curators, and docents. These individuals may be paid museum employees or volunteers.

I exerted effort to ensure that I would be able to recruit research sites that overall covered all three disciplinary foci, art, history, and science. This was to ensure cross and multi-disciplinary analysis of data. The first step was to identify museums interested in participating. The criteria I used for selection was that the museum had among its education program offerings an educator or museum staff-led school programs held on-site. Programs could be held either in the museum exhibition galleries, lobby, courtyard, museum classrooms, or a combination of these. Second, the program should be for foundation to secondary school groups. The program could have an art, history, or science focus to ensure the possibility for a cross and multi-disciplinary analysis of data. Third, the educator in these programs should be utilising other elements of the environment and not just the objects/artworks/artefacts/specimens displayed as part of the exhibition. These elements may include wall texts, objects/artefacts/specimens not part of the exhibition, iPads, show me boards, flashcards, photos, or books carried by the educator or part of the gallery that they specifically use for conducting the program.

I initially contacted the purposely selected museums via e-mail. The first line of contact was either the museum director or head of education. Some of these contacts were referred by fellow researchers who had previously established working relationships with museums (snowball sampling). In the initial e-mail, I took the opportunity to introduce the research project briefly and then asked to arrange a meeting, when possible, or a phone call with the recipient. Copies of the Plain Language Statement and Consent Form for museums and were sent with the first email. I developed a phone census protocol as a guide to direct my conversation with contacts from potential sites. During the meeting or phone call, I explained further details of the project. Questions and concerns were also addressed during these meetings or phone calls.

After the initial meeting or phone call, the museum contact secured the necessary permissions from within their institution to participate in the research. Seven institutions agreed to participate in this case study. Six were from three different states in Australia (Australian Capital Territory, New South Wales, and Victoria) and the seventh was from Wellington, New Zealand. These participating institutions were composed of four museums, two of which were national museums, two art galleries, and one combined museum and gallery. For simplicity, I will refer to all these institutions as 'museums' in the subsequent sections.

Case study 2: Museum educator-led incursions into schools

Museums embark on activities that go beyond the museum's premises to expand its audience reach. Like other museum education programs, these are also designed with a specific target audience in mind and generally fall under the museum's 'outreach program'. Many museums have outreach programs designed for groups of students who are unable to physically go to the museum to see an exhibition or participate in an education program. These programs may include, but are not limited to (a) travelling exhibitions, which are designed to be easily dismantled and assembled in different locations outside the museum; (b) online exhibitions; (c) travelling suitcases, which are learning kits loaned or purchased by schools that come with museum objects, teaching materials, and sometimes multi-media components; (d) classroom programs, where a museum educator or volunteer travels to a school and conducts the activities there; and (e) video conferencing, where a museum educator teaches the program through a live video feed. Museums are not the only institution that offer outreach programs for schools. There are also companies that specialise in developing education programs that are held within the schools' premises, which are generally called incursions.

Both purposive sampling (Kerlinger, 1986; Patton, 2002) and snowball sampling (Biernacki & Waldorf, 1981) were also utilised for Case Study 2. This case study focused on investigating how museum educators used spaces and objects beyond the museum premises in conducting education programs for school groups. The aim of this case study was to document what and how museum educators used elements of other learning environments in tandem with deep learning strategies to facilitate students' deep learning. This case study was also designed to record the various types of teaching materials, tools, and equipment that museum educators brought with them and used when they taught outside confines of the museum with which they were affiliated. This case study was included because I was interested to see whether museum educators' teaching practices change when they are no longer inside the museum. Additionally, since this research ultimately aims to inform school teachers' classroom practice, I felt that this case study would help demonstrate the applicability of museum educators' strategies inside school classrooms. I wanted to investigate how museum educators teach inside school classrooms.

Similar to Case study 1, the first step was to identify museums interested in participating. Convenience sampling, a type of sampling where members of the target population meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate (Dörnyei, 2007), was used to identify sites that were easily accessible to the me (Saumure & Given, 2008). In the current study, the convenience sample included all museums located in Melbourne.

The criteria I applied for the selection of museum was that the museum had to have among its education program offerings an off-site or incursion program led by an educator or museum staff. Second, the program may be held inside school premises or other non-school facilities as long as the attendees of the programs were school groups. The program can have art, history, or science focus, again, for cross and multi-disciplinary analysis of data. Third, the educator in these programs should have been utilising more than one element of the environment for teaching. In the same vein as Case Study 1, elements educators used may include wall texts, objects/artefacts/specimens, iPads, show me boards, flashcards, photos, or books brought by the educator or already in place in the learning environment used for the program.

I compiled a list of museums in Melbourne from online searches and showcase this in **Table 5.2**. Websites of each of these museums were then checked to find out whether they offered off-site education programs to schools.

Table 5.2

List of museums in Melbourne

Museums in Melbourne	
ANZ Banking Museum	Jewish Holocaust Museum and Research Centre
Australian Centre for Contemporary Art	Jewish Museum of Australia
Australian Centre for the Moving Image	The Johnston Collection
Australian Lesbian and Gay Archives	Koorie Heritage Trust
Australian National Aviation Museum	La Trobe's Cottage
Australian Racing Museum	Living Museum of the West
Australian Railway Historical Society Museum	Melbourne Maritime Museum
Backwoods Gallery	Melbourne Museum
Centre for Contemporary Photography	National Gallery of Victoria
Chinese Museum, Melbourne	National Steam Centre
City Gallery, Melbourne	National Sports Museum
Cooks' Cottage	Old Melbourne Gaol
Dax Centre	Old Treasury Building, Melbourne

Museums in Melbourne	
Fairhall (House Museum)	Portable Iron Houses
Fo Guang Yuan Art Gallery	RAAF Museum
Grainger Museum	The Shrine of Remembrance
Hellenic Museum, Melbourne	Scienceworks
Ian Potter Centre	Shot Tower Museum
Ian Potter Museum of Art	Victoria Police Museum
Immigration Museum, Melbourne	Victorian Telecommunications Museum
Islamic Museum of Australia	

I identified four museums with off-site education programs and contacted them through email or by phone to reach out to the staff in-charge of the program. The objective of the email or phone call was to introduce the research and request a face-to-face meeting. The same process applied in Case study 1 was duplicated in Case study 2. A copy of the Plain Language Statement and Consent From for the museums and were sent with the first email.

Three museums agreed to the face-to-face meeting, and two were recruited to participate in the study. The museum contacts secured the necessary permissions from within their institution to participate in the research.

I also reached out to museum colleagues in Victoria to ask if their museum or if they know of museums that offer outreach programs to schools. This resulted in two more potential sites that were subsequently contacted via email or phone. Unfortunately, neither attempts resulted in successful recruitment.

A colleague from the ILETC Project reached out to a former colleague who ran a company conducting education programs or incursions to schools in Victoria. While this company was not a museum, it was included as a potential site for a number of reasons. First, an educator not affiliated with the schools led the programs. Second, the school program was held within the school premises and not in a museum. Third, the educator brought into the school their own materials, tools, and equipment necessary to conduct the program.

I had a phone meeting with the head of the company after which copies of the Plain Language Statement and Consent Form for museums were sent through email. This company was successfully recruited to participate in the study.

This case study focused on school incursions offered by three participating institutions. Two of these institutions were museums located in Victoria. The third institution was a private company offering educational services to schools in Victoria, for simplicity and consistency I will also refer to this institution as museum.

Case study 3: School teacher-led Excursions into museums

This Case Study was intended to find out what and how school teachers used elements of museum galleries or museum classrooms to facilitate students' deep learning. The location for collecting data remained within a museum's premises. However, participating 'sites' were schools that enabled school teachers to bring their students to museums for a field trip. The teacher must have been the one leading students through the museum or conducting the program instead of a museum staff.

From October to December 2016, the ILETC project ran a Space Design and Use (SDU) survey of school principals in Australia and New Zealand (Imms et al., 2017). The SDU survey was intended to find out the number and types of innovative learning environments that were currently used, the nature of teacher mind frames, and the variety of student learning occurring in these environments. The online survey was sent to 6139 principals or their nominated delegate, from which 822 complete responses were received. It was from these responses that the potential sites for Case Study 3 were initially drawn.

Of the five thematic sections in the survey, this research utilised responses centred on a) teacher mindframes; b) student deep learning; c) teaching approaches; and d) learning and teaching affordances. One section on the types of spaces in schools were not relevant in the context of the present study as the research sites were museum premises. An overview of four thematic sections of the SDU survey is provided here, which is summarised from Imms et al. (2017).

The teacher mind frames subscale derived items from the eight mind frames, or ways of thinking, that underpin those actions and decisions of teachers and leaders that are likely to have significant impacts on student learning (Hattie, 2012). An example of an item was “In my opinion, teachers at our school believe that their fundamental task is to evaluate the effect of their teaching on students' learning and achievement”. Respondents were asked to rate each item on a four-point rating scale of Strongly Agree, Agree, Disagree, and Strongly Disagree. A combination of averaged responses with application of 955 confidence intervals showed an overall mean of 3.06.

The item for the student deep learning subscale were drawn from the Learning Process Questionnaire (LPQ) (Biggs, 1987; Biggs, Kember, & Leung, 2004). Ten items from the survey's deep approach scale were selected for the SDU survey based on relevance to the variables being examined. An example of an included item was “In my opinion, students at our school try to relate what they have learned in one subject to what they learn in other subjects”. Respondents were asked to rate each item on a four-point rating scale of Strongly Agree, Agree, Disagree, and Strongly Disagree. The responses returned an overall mean of 2.77, with application of 95% confidence interval.

The SDU survey adopted a typology of six teaching approaches ranging from whole-class to individual-student teaching practices. Respondents were asked to indicate the percentage of time devoted to each teaching typology in their school. The proportion of teaching approaches were recorded, with teacher-led pedagogies (typology 1 and 2) being most prevalent (51%).

The subscale on learning and teaching affordances (Gibson. 1979) consisted of items that relate to availability and use of digital, physical, and spatial provisions found in school learning spaces that act as affordances for teaching and learning. This section asked respondents to rate how well teaching and learning affordances (Gibson. 1979) meet the needs of student learning in terms of the school's desired pedagogy on a four-point Likert scale of Excellent, Good, Satisfactory and Poor. Means for each item ranged from 2.3 to 2.89.

The following criteria (**Table 5.3**) were applied to the responses to identify target schools:

Table 5.3

Selection criteria for potential schools

Subscale	**Selection criteria**	**Target**
Teacher mindframes	Means of all teacher mindframes items	Schools with means above 3.06
Student deep learning	Means of all student deep learning items	Schools with means above 2.77
Teaching approach	High proportion of teaching approach 4: Collaborative/shared learning, supported by teachers as needed	Schools which utilised collaborative /shared learning (50% and above)
Learning and teaching affordance (Gibson. 1979)	Mean of items 4 and 5: Adequacy of display resources	Schools with means above 2.3 for these items
	Mean of item 8: Adequacy of furniture and floor area	Schools with means above 2.3 for this item
	Mean of item 6: Adequacy of hands-on resources	Schools with means above 2.3 for this item

I identified 14 schools as potential sites. I called the principals or their delegate from these 14 schools while following a protocol I designed for speaking with potential sites for Case Study 3. The aim of the phone call was to introduce the research project briefly. Then I asked if the school had teachers who were using museums as part of their curriculum (i.e. collaborating with museums for specific activities/programs or bringing their students to museums for field trips.). Finally, I enquired whether these teachers were scheduled to bring their students to a museum between July and December 2017. If after three attempts, speaking to the principal remained unsuccessful, I sent the school an email to briefly introduce the research and request for a scheduled phone meeting. Copies of the Plain Language Statement and Consent Form for schools were also sent with the email. Unfortunately, none of these 14 schools was successfully recruited, and alternative recruitment approaches were then pursued.

Two museums, one in Australia and another in New Zealand, agreed to seek permission from 12 schools who booked field trips with them to allow me to contact them about the study. None of the schools was successfully recruited either. The schools' reasons for declining to participate included, but were not limited to, the following:

- They were not interested in participating.
- Students were visiting multiple sites during the field trip. Hence, they would have had very limited time to explore the museum.
- The teacher was not facilitating an activity during the museum visit.
- The trip was considered as a reward for high achieving students, and they were to be given the freedom to explore the museum on their own and pursue their own interests during the museum visit.

The ILETC Project also sent emails to its distribution list consisting of approximately 1000 schools. The email inquired whether the schools had students going on a field trip for Term 3 or 4 of 2017 (July to December) and if schools were interested in participating in the study. Three affirmative responses were received. After further investigation, however, it was deemed that none of these schools fit the site selection criteria for Case Study 3. Colleagues from the ILETC project also reached out to museum and school colleagues in Victoria to ask if they were bringing their students to a museum between August and December 2017. No successful recruitment came out of this endeavour.

Despite multiple efforts, no successful sites were recruited for Case Study 3. Therefore, Case Study 3 will no longer be discussed in the succeeding sections of this chapter. The next chapters focused on reporting findings from Case Study 1 and 2. To simplify case study names and because there were no school teachers who participated in this research, from this point forward, I will use Excursion into museums for Case Study 1 and Incursion into schools for Case Study 2. Removing Case study 3 did not have a significant impact on the study. The research questions required participation of museum educators since it is their practice that I was interested in investigating. Target participants of Case study 3 were school teachers, and the opportunity to observe them teach in museums would have added another dimension to the richness of the study. However, data from the two case studies were more than sufficient to accomplish the goal set for this research.

5.1.3 Participants

The institutions, who I contacted and have agreed to participate in the study, were the ones who identified educators from within their museum to become study participants. To be clear, participants of this study were the educators, and not the institutions. Twenty-three individuals for Excursion into museums participated in the study. Out of the 23 participants, 21 allowed me to observe them conduct education programs for school groups in their respective museums. I observed some of them multiple times as they taught different programs for different school groups while I observed others only once. This resulted in 29 program observations that were held between 30 minutes to three hours. Nineteen of them agreed to further participate in a short post-observation interview. Two additional participants were interviewed but were not observed, resulting in just 21 interviews. All 23 participants, except for one, Educator 28, were employed as museum educators during the time the case study was conducted. I included him in the study even though I did not have a chance to observe him conduct a program because he designed the venue and created the education programs for the Learning laboratory, Museum 9's new learning room. The other participant, Educator 15, also participated only as an interviewee and provided additional context on how programs at Museum 5 were organised and conducted. **Table 5.4** provides a summary of the participants, the institution they represented and its location, learning areas their program focused on, and the number of times I observed them conduct a program. The learning areas listed are based on the national curricula used by Australia or New Zealand. In some cases, a single program addressed more than one learning area, as reflected in the table. It is also important to mention that while official titles of participants may vary per institution, they were all paid staff members who delivered education programs in their respective museums.

Table 5.4.

Details of participants for Excursion into museums

Institution	**Participant**	**Learning area**	**Number of programs observed**
Museum 1	Educator 1, Museum 1	Humanities and Social Science	2
Museum 2	Educator 2, Museum 2	The Arts	1
Museum 3	Educator 3, Museum 3	Humanities and Social Science	2
	Educator 4, Museum 3	Humanities and Social Science	1
	Educator 5, Museum 3	Humanities and Social Science	1
Museum 4	Educator 6, Museum 4	Science	1

Institution	Participant	Learning area	Number of programs observed
	Educator 7, Museum 4	Science	1
	Educator 8, Museum 4	Science	1
Museum 5	Educator 9, Museum 5	Science Humanities and Social Science	2
	Educator 10, Museum 5	Science	1
	Educator 11, Museum 5	Science	1
	Educator 12, Museum 5	Science	1
	Educator 13, Museum 5	Science	1
	Educator 14, Museum 5	Science	1
	Educator 15, Museum 5	-	-
Museum 6	Educator 16, Museum 6	The Arts	1
	Educator 17, Museum 6	The Arts	2
	Educator 18, Museum 6	The Arts	1
Museum 9	Educator 24, Museum 9	Social Science	1
	Educator 25, Museum 9	The Arts Social Science	1

Institution	Participant	Learning area	Number of programs observed
	Educator 26, Museum 9	The Arts Social Science Technology	4
	Educator 27, Museum 9	The Arts Social Science Technology	2
	Educator 28, Museum 9	-	-

Note: Names have been changed to maintain the anonymity of participants.

Five educators from Incursion into schools agreed to participate in the study. Three were from Museum 8, and one each from Museum 6 and Museum 7. Note that, as stated earlier, museum 7 is not a museum. The participant from this institution was not a museum educator, however, for simplicity and consistency, I will also refer to this participant as a museum educator. This case study included 13 incursion program observations that ran for a period of one to two hours. I observed participants conduct a program for more than one group of students except for one, Educator 21, whom I observed teach a program only once. All five participants agreed to a post-observation interview. I interviewed two participants, Educator 19 and Educator 20, face-to-face and immediately following their last program that I observed. The three other participants were interviewed over the phone later. Names of participants, the institution each of them represents, the learning areas addressed by their program, and the number of programs conducted by each of them that I observed are summarised in **Table 5.5**. Similar to the Excursion into museums case study, all participants in Incursions into schools case study were paid staff members of institutions that they represented.

Table 5.5.

Details of participants for Excursion into schools

Institution	Participant	Learning area	Programs observed
Museum 6	Educator 19, Museum 6	The Arts	3
Museum 7	Educator 20, Museum 7	Science	2
Museum 8	Educator 21, Museum 8	Humanities and Social Science	1
	Educator 23, Museum 8		3
	Educator 22, Museum 8		4

Note: Names have been changed to maintain the anonymity of participants.

In accordance with approved ethics guidelines of keeping participants' identities anonymous, they were assigned a code from Educator 1 to Educator 28 in all public reports resulting from this study. The anonymity and the confidentiality of participants' responses were protected to the fullest possible extent, within the limits of the law. References to personal information or context, which might allow someone to guess participants' identities, have been removed. However, due to the small number of people recruited for the study, a participant may still be identified.

5.1.4 Data Collection

The case study approach does not dictate a specific set of strategies and techniques with which to conduct the research (Flyvberg, 2004; Stake, 1995). I chose methods of data collection that allowed me to observe and understand the complex nature of museum educators' teaching student groups. However, due to the complex nature of teaching in museums, I needed to employ multiple methods of collecting data to examine different facets of the museum educators' teaching practices. Using multiple data sources is one of the key features of case study research (Baxter & Jack, 2008). Additionally, in Phipps' (2010) analysis of research studies from 1997 to 2007 that utilised the Contextual Model of Learning (Falk & Dierking, 2000, 2005), she identified four major categories of data collection methods: observations, interviews, surveys, and written artefacts. This study applied and used three primary data sources: (a) program observations; (b) semi-structured interviews with participants; and (c) research journals. Other sources of data include audio recordings of the programs observed, teaching artefacts (worksheets and handouts), and photographs of the learning environment and elements within. I used these secondary data sources, combined with the primary data, for triangulation (Willis, 2007). Triangulation refers to the use of more than one source of data to generate a richer, fuller data and to help confirm the results of the research (Wilson, 2014).

I found that listening to the audio recordings of program observations was useful for recalling and re-creating the sessions when certain observed data required confirmation. One participating museum requested that I do not record the programs of their museum educators that I observed. It is also noted that no people were included in any of the photos taken of the learning environments. A summary of the various sources of data is presented in **Figure 5. 2** and described in **Table 5.6**.

Figure 5.2 Summary of data collected

Table 5.6

Data sources

Type of data source	**Description**
Program observations	Physical observations of education program conducted by participants
Research journals	Observations, reminders, 3P (participant, place, process) remarks about participant, learning environment, and data collection procedure, and other observational notes and reflections that I wrote down in my research notebook
Interviews	Semi-structured interview done after observation
Program audio recordings	Audio recording while participants conduct the program being observed
Photographs	Photos of the learning environment where the program was held and elements within that participants used in aid of teaching
Teaching artefacts	Materials handed out to students for use during or after the program

There is, however, the danger of collecting too much data (Merriam, 1988) and researchers getting overwhelmed easily by the number of details (Stake, 1995). To avoid being overwhelmed with and over-collection of data, a data collection protocol was developed. A protocol, according to Yin (2009), is essential for conducting a multiple-case study as it contains not only the instrument for collecting but also the procedures and general rules for data collection. The protocol was developed with the research questions at the forefront to ensure that data that were collected will be able to answer these as well as meet the study's objectives. Consistent with the conceptual framework articulated in Chapter 4, data collected were focused on elements of the learning environment, affordances (Gibson, 1979), and deep learning strategies of museum educators. Even though this study is theory-driven, it was also data-driven as I also took note and paid attention to emerging themes.

The following sections provide further details on the observations and interviews completed for the study.

Observations

Observations were held when museum educators taught school groups during scheduled school visits to museums and when they went off-site (outside the premises of the museum) to conduct activities for student groups. The observation was intended to document actions made by the participant that were relevant to the key themes of the study. Using the Contextual Model of Learning (Falk & Dierking, 2000, 2013) helped me identify where to look and how to look for museum educators' teaching practices.

I was able to observe each of the participants for at least one session, with the exceptions mentioned earlier. Other participants were observed multiple times, as many as four, while conducting the same session with different groups of students. Some of these sessions were also held in different venues. The length of observation depended on the duration of the program. The shortest program I observed was 30 minutes, and the longest lasted three hours. Program observation sessions were conducted during Terms 3 to 4 of 2017. Observations completed for the study are summarised in **Table 5.7**.

Table 5.7

Summary of observation sessions

Institution	Number of participants	Number of observations	Total duration (hours)
Case Study 1			
Museum 1	1	2	3.5

Institution	Number of participants	Number of observations	Total duration (hours)
Museum 2	1	1	1
Museum 3	3	4	5
Museum 4	3	3	3
Museum 5	6	7	6.75
Museum 6	3	4	4
Museum 9	5	8	13.5
Case Study 2			
Museum 6	1	3	5.35
Museum 7	1	2	2.5
Museum 8	3	8	8.2

Since I expected that multiple events and actions would be simultaneously happening during one program, I needed to focus my attention and notation on data that contributed to answering the study's research questions. To assist with this goal, I developed an observation checklist. The checklist was designed to allow me to record what (elements) and how (affordance) participants used the spaces and objects within the learning environment for teaching. It also included a section where I could note down the different deep learning strategies utilised by the participant. The development of the observation checklist is described in the next section.

Development of the observation checklist

I developed an observation checklist since one capable of recording the specific data this study was concerned with did not exist. The critical categories of the checklist (physical, personal, and sociocultural) were drawn from the factors of the Contextual Model of Learning (Falk & Dierking, 2000, 2013), as discussed in Chapter 4. **Figure 5.3** demonstrates how Falk and Dierking's framework was applied in this study and translated into an observation checklist to help record how museum educators were using elements of the learning environment for students' deep learning. The observation checklist is also available in Appendix A.

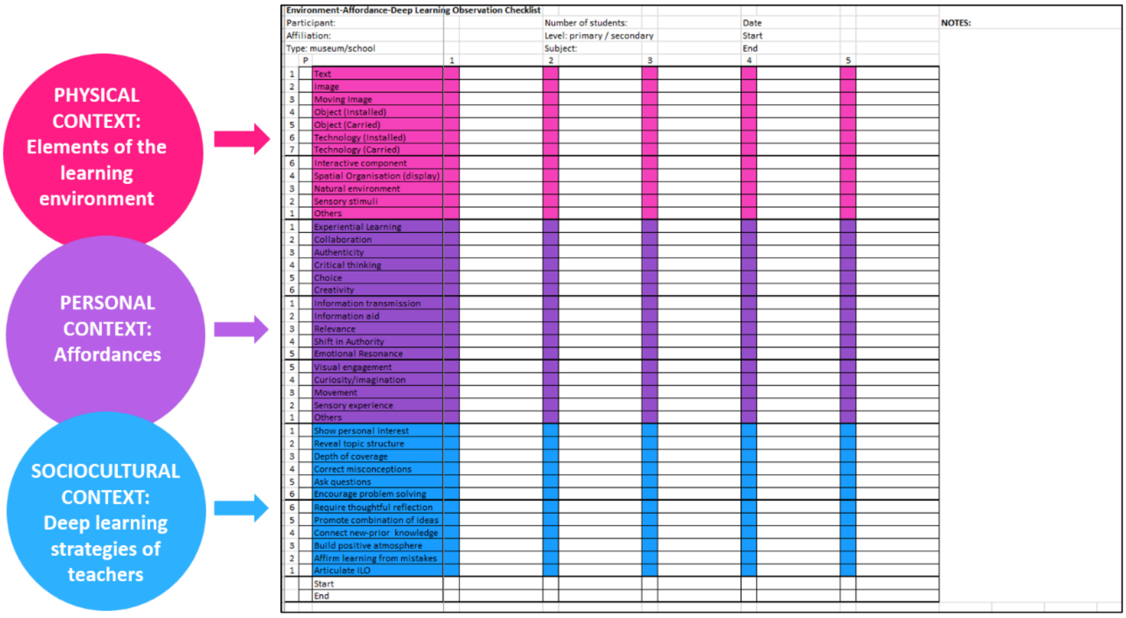


Figure 5.3. The Conceptual Model of Learning reified as an observation checklist

The physical context, or what the museum educators are using, was reified as the elements of the learning environment that they are using to support students' deep learning. For brevity, I will refer to these as 'elements' throughout the rest of the thesis. It is important to note that I have opted to use 'elements' instead of 'objects' because what participants used for teaching were beyond materials that could be touched such as sensory stimulus (i.e. sound and smell) and spatial organisation. Specific items under this category were drawn from literature, discussed in Chapter 2, as well as my personal experience as a museum educator for the past two decades.

The personal context, how the museum educators are using these elements for teaching, was reified as affordances (Gibson. 1979). Items under this category, similar to elements, were also drawn from both literature and my personal experience. The sociocultural context was reified as the strategies that museum educators employ to support students' deep learning. These strategies were drawn from the list of factors proposed by Biggs and Tang (2007) combined with those of Houghton's (2004). I operationalised and modified these factors to ensure that strategies are explicit and could be observed. These strategies are enumerated below:

1. Demonstrates personal interest in the topic

2. Brings out the structure of the topic/subject
3. Allows ample time to cover the topic
4. Points out and corrects students' misconceptions
5. Engages students in active learning through open-ended questions
6. Presents students with problems to solve
7. Chooses activities requiring thoughtful reflection
8. Encourages students to combine different ideas
9. Builds on students' prior knowledge and connects to new information
10. Cultivates a positive atmosphere that allows students to make and learn from their mistakes
11. Affirms students learning from their mistakes
12. Clearly articulates learning outcome for the lessons

I also anticipated that initial plans for data collection could drastically change (Willis, 2007). Hence, I felt the need to test the checklist before the first scheduled data collection. I tested the first iteration of the checklist four times in a museum in Victoria. My intention was to check the usability of the checklist for recording the actions of someone leading a group of people through the galleries. Data was not collected for these test runs.

During the first round of data collection in New South Wales, I decided to add a space labelled 'others' in both Elements and Affordance sections. This was to allow me to record emergent categories and information that was not initially included in the checklist. One of the most critical issues I had with the first version was lack of space to write information on the type of element being used. Documenting the specific type of element was of major importance in building a list of the various elements within the learning environment that museum educators may use. Hence, I further modified the checklist to accommodate these.

Semi-structured interviews

After observing participants, semi-structured interviews were subsequently scheduled to discuss results of the observation and clarify any further questions that arose from the observations. I interviewed participants after I had completed observing all their scheduled program within the scope of my data collection period. The interviews lasted between 17 to 40 minutes. An audio recording device was used to capture exact words used by participants during interviews (Stake, 1995).

Ideally, interviews should have been conducted face-to-face. However, certain situations prevented these from always being the case. There were times when participants had back to back programs to facilitate or had other work-related activities to attend to immediately. In some instances, participants were not full-time employees at the museum and were at the museum only when they had scheduled programs to facilitate. As a result, some interviews were scheduled at a later date and I conducted them on the phone. This also meant that three of the participants, despite my best efforts, were not available for the follow-up interview. **Table 5.8** provides a summary of the interviews completed for the study.

The objective of the interview was not only to confirm, but also clarify, or triangulate data. It was also intended to provide additional information to help me understand the participant's teaching practice. The observation session only allowed me to see a small snapshot of the participant's practice. I was cognisant that museum educators' use of elements and affordances might vary depending on the program, intended learning objective, participants, and program venue. Therefore, asking participants about ways they used other learning environments at different times and places was essential in building a robust list of elements and affordances.

One additional participant from Museum 9, as explained earlier, was interviewed despite the fact that I did not observe him conduct an education program. Including him was a deviation from the pre-set protocol. However, it was a unique opportunity to gain a deeper understanding of Museum 9's Learning laboratory (name of the facility changed to retain anonymity). This venue was purposely built as an innovative learning environment. This participant designed the Learning laboratory and the initial set of programs that were being offered there.

Table 5.8.

Summary of interviews

Institution	Number of participants	Number of interviews	Total duration (hours)
Case Study 1			
Museum 1	1	1	.5
Museum 2	1	1	.30
Museum 3	3	3	1.25
Museum 4	3	3	1.13
Museum 5	7	5	2.25
Museum 6	3	2	.80
Museum 9	5	5	2.16
Case Study 3			
Museum 6	1	1	.38
Museum 7	1	1	.34
Museum 8	3	3	1

Research journals

I maintained research journals during my data collection. In these journals, I wrote snippets of the programs I observed, including salient moments during the session. I wrote my notes around four Ps: 1) People, the participant I was observing and interviewing; 2) Program, the museum education program the participant was facilitating; 3) Place, the location of the program, where it was, and how it looked and felt like; 4) Process, notes about my data collection process, what worked or did not work and how I could improve these. Research journal entries were written during or immediately after the observations.

I referred to my research journal to help me write vignettes, or short descriptive accounts, included in the succeeding chapters (Chapters 6, 7, and 8). Vignettes are retelling of the observations and includes actions and words spoken by participants as well as responses and reactions from both the participants and the students. These were written based on multiple data sources such as entries from my research journal, photos taken during the session, audio recordings, and other data sources. In some cases, I included excerpts from my research journal as data presented to support findings. In these instances, I clearly state that the data is from my research journal.

Figures 5.4 and **5.5** summarise the data collected for Case Study 1 and 2.

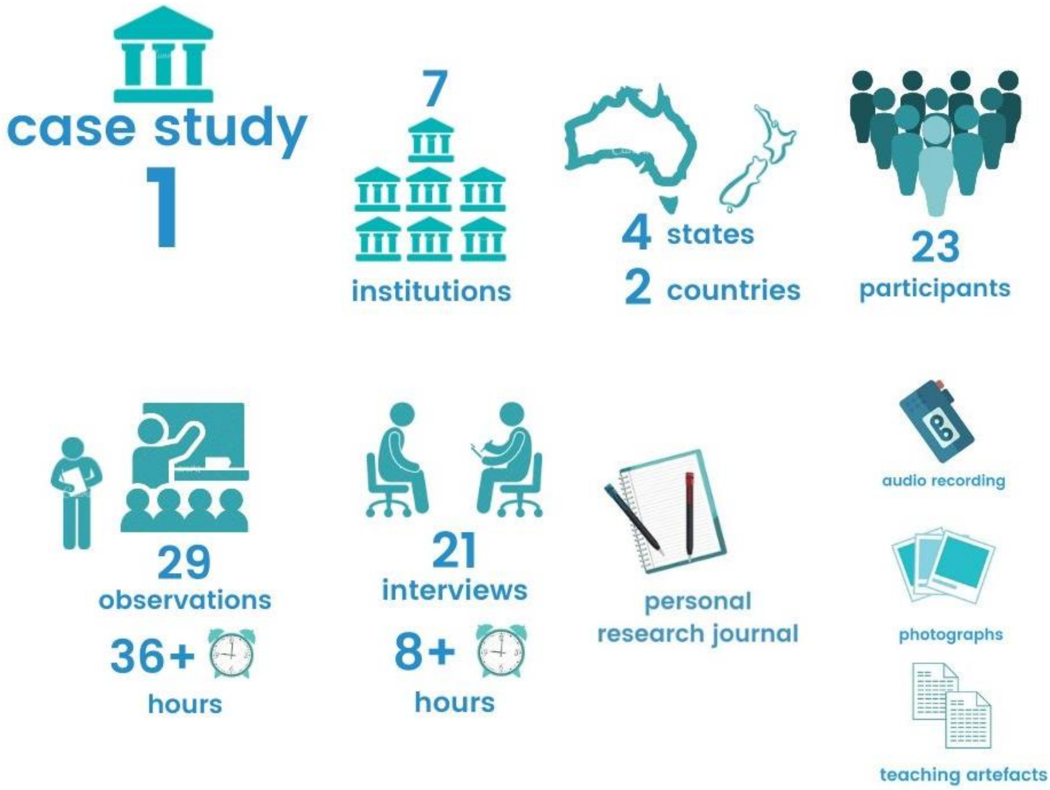


Figure 5.4. Data sources for Excursion into museums case study

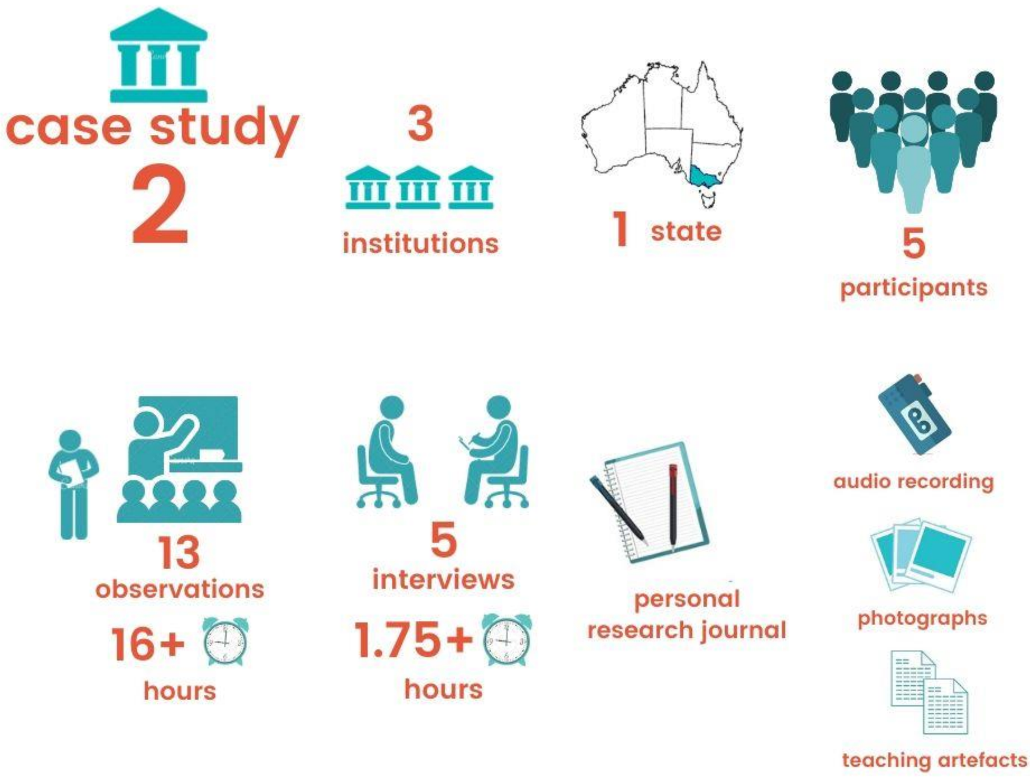


Figure 5.5 Data sources for Incursion into schools case study

5.2 Analysis

To analyse data from this study, I applied a "data analysis spiral" (Creswell, 2007, p. 150), which meant that I moved in analytic circles instead of analysing my data in a fixed linear way. Patton (2002) argued that using a spiral process of investigation blurs the distinction between data collection and analysis in qualitative research. While this results in an entangled data collection and analysis, this also allows each to nourish one another (Caulley, 1994). By analysing data early, researchers will have the opportunity to re-think their initial data, which may subsequently lead to more appropriate questions, and, ultimately, result in generating stronger data (Hurworthy, 1996).

The wealth of data collected for this study meant that a data analysis software was useful in examining, categorising, and tabulating data to help answer the research questions. I used NVivo, a qualitative data analysis software, to manage all the data collected. Use of NVivo enabled easier tracking, organising, and future retrieval of the different data sources, which in turn improves the reliability of the study (Baxter & Jack, 2008).

I used the Conceptual Model of Learning (Falk & Dierking, 2000, 2013) discussed in Chapter 4, as a framework to analyse qualitative data collected centred around (a) elements of the learning environment, (b) affordances, and (c) deep learning strategies. In this study, I adopt the ILETC definition of a strategy as "as an explicit concept, theory or practice" (Mahat, Bradbeer, Cattlin, & Imms, 2019, p. 14). During the coding process, these three themes served as my "lean coding" (Creswell, 2007, p. 152), or a short list of major categories. Under these categories are more sub-categories. I noted down in the checklist what the teacher used (elements), how it was used (affordances), and strategies employed to cultivate deep learning in students (deep learning). However, I also recorded details that did not fit within my predetermined list and these were included among the emergent categories (Crabtree & Miller, 1992). Initial coding was carried out to identify similar concepts. These codes were further refined and modified by revisiting the data to explore similarities and differences (Cohen et al. 2007). I went through the data a number of times to review emergent categories.

Once all the data had been coded, they were matched with the relevant research questions. This strategy, relying on theoretical propositions, linked evidence from data collected to the original case study design and objectives (Yin, 2009). Drawing from the primary and secondary data sources, I developed vignettes or short descriptive accounts, that enabled me to link evidence to theoretical propositions. As stated earlier in this chapter, these vignettes were written based on multiple data sources such as entries from my research journal, photos taken during the session, audio recordings, and other data sources also outlined in the chapter. An example of a vignette is provided below.

The vignette is about one observation for an Excursion into museums case study. It relates to an education program that was held in a historic property, a homestead, managed by Museum 1. To protect the anonymity of the participating museum, I will refer to this museum education program as Life of convicts. This particular session was facilitated by Educator 1 for a group of 24 primary school students. Life of convicts was designed to help students understand Australia's colonial past, particularly the everyday experiences around early European settlement, the convict system, and life of assigned convicts. Between 1787 to 1868, approximately 139,000 men and 26,000 women were transported to the Australian penal colonies from Britain (Maxwell-Stewart, 2011). A system of labour was established by Governor Arthur Philip in which people, regardless of the crime they committed, were employed according to their skills—as brick makers, carpenters, nurses, servants, cattlemen, shepherds and farmers (Australian Government, 2014). While most convicts were tasked to build roads, causeways, bridges, courthouses, and hospitals, a smaller number worked for the European settlers and small landowners, such as the homestead where the program was held. Life of convicts was intended to provide students with insights into the everyday experiences of convicts who were assigned as servants through object analysis and exploration of the convict-built buildings on the property.

The vignette represented only about 20 minutes of the 90-minute session. I narrate how the session unfolded then annotated the text to show examples of elements used by a participant and specify its corresponding affordances. Lastly, I call attention to strategies employed by the participant to cultivate deep learning in students. Text highlighted in purple are elements of the learning environment and how these were used for teaching (affordances). Deep learning strategies used by Educator 1 are highlighted in blue. Those that are highlighted in pink are the deep learning strategies that were employed with the use of an element in the learning environment.

Vignette 1: A different time, a different life

After greeting the students good morning, Educator 1 invited them to sit down on the mats spread in front of her. They were gathered in an open outdoor space designated as the museum's garden. There were a few trees, but no other seats or furniture were set-up in the garden. While she started the session standing in front of the students, she sometimes walked to the side and around the mats as she talked to the group.

Element: Mats
Affordance: Spatial flexibility

Element: Macro spatial organisation
Affordance: Spatial flexibility

Element: Macro spatial organisation
Affordance: Allow movement

She told the students that they were going to learn that day about the past, particularly about convicts. She added that they would have an opportunity to investigate and discuss the life of the convicts who used to work at the homestead. She continued to say that historians believe that 150 years ago, convicts used to work at the homestead. "Look up into the horizon out there", she said while pointing towards the open field behind her. "Can you see hills with trees on them?" After hearing the collective agreement of students, she continued to say that convicts used to go out into those hills with "one, two, or three hundred heads of sheep", adding that the convicts had to look after the sheep. She enumerated a few of the tasks the convicts had to do in taking care of and ensuring that these sheep produced good quality wool for their employer, the land owner of the homestead.

Deep learning: Bring out structure of topic/subject, articulate intended learning outcome

Element: Natural environment
Affordances: Create authenticity, Illustrate concept, Provide relevance, Promote visual engagement, Spark curiosity

"But who were these convicts? What's a convict?", she asked. She called on one of the students who had his hand raised. This student shared a name of a person. "Oh, you know a name of an actual convict who worked here at Lanyon!", Educator 1 exclaimed. "Why did he become a convict?" She encouraged the same student to share what else he knows about this person and how he became a convict. Using the information that the student shared as a starting point, she continued to have an animated conversation with the group about what crimes some were convicted of and where they were originally from. Occasionally exclaiming "Oh my goodness" or saying "Gosh, how interesting!", after another student explained that one convict was sent to Australia for stealing beddings. She asked questions such as, "where were they coming from?", "why were people committing all these crimes in places like England, Ireland, Wales, India...?", "does anyone know why they didn't have any money?" , and "why didn't the convicts stay in Sydney town, go to the Art Gallery of New South Wales, and have a nice time at the coffee shops?". At some point, she remarked, "Very well done! The convicts were assigned to James Wright to work here."

Deep learning: Engages students in active learning through open-ended questions

Deep learning: Builds on students' prior knowledge and connects to new information

Deep learning: Demonstrate personal interest in the topic

Deep learning: Engages students in active learning through open-ended questions

Deep learning: Provides connections with real world situations

She reminded the students that since none of the current people working at the homestead, including herself, were alive 150 years ago when the convicts were working there, they do not know exactly how they lived then. However, there are people called historians who, after conducting research, confirmed that convicts were working at the Lanyon and helped them understand what life was like for them. "One of those historians is a bit like…" she trailed off before continuing, "Indiana Jones. Who's Indiana Jones? How many knows who's Indiana Jones?" She then counted the number of little hands that went up. One student shared what he knows about the fictional movie character. "Ahhh, he was an explorer! He went out into the world and found gold, jewels… and when he finds those things he'd say - this belongs in a…?", she paused. "A museum!", a few students shouted in chorus. "Oh, you even know the script of the movie!". She added that Indiana Jones, in movies, is also a renowned archaeologist. She continued to explain what an archaeologist like Indiana Jones does and added that the students would do something similar during their activity for the day. She described what they were going to do and where they were going.

Deep learning: Provides connections with real world situations

Deep learning: Builds on students' prior knowledge and connects to new information

Deep learning: Brings out structure of topic/subject

Afterwards, Educator 1 instructed students to each get a clipboard from a box that was sitting close to the garden's exit. Attached to each clipboard were several papers and a pencil.

She asked students to form two lines and then led everyone out of the garden into an open field where a stone structure with a shingled roof stood next to a small pond. I later learned that this building is a stone barn built by the convicts. **Figure 5.1** shows students walking towards the stone barn. She asked an adult to carry the blue plastic box containing some additional materials for the activity.

While walking towards the stone barn, she continued conversing with some of the students and answered a few of their questions including what was going to happen during the session later or what the fences students could see around the property were made from. She reminded the students to observe their surroundings. "Historians are very observant. We are moving through this paddock towards a building down at the bottom. As you are walking down, notice as much as you can." Educator 1 was talking and walking in a windy open field, without a portable microphone or bullhorn. She had to speak

Deep learning: Brings out structure of topic/subject

Figure 5.6. Students walking towards the Stone Barn

without a portable microphone or bullhorn. She had to speak loud enough so that students at the end of the two lines could still hear her.

They arrived in front of the stone barn but didn't enter. They stopped about seven meters from it. Mats, which appear to be made of tarpaulin were distributed. Educator 1 then asked them to spread out in the open space but stand in a single line then face the stone barn. All 24 students stood facing the side of the barn. They were in front of a solid stone wall painted white. Educator 1 positioned herself in the empty space between the building and the students.

Element: Macro spatial configuration
Affordance: Spatial flexibility

"Now that you've had time to observe, to look at this building, tell a person next to you all the materials you can see the building is made from. Go!". I heard some students say metal, brick, rock, wood, and paint. Other students even started discussing the condition of the building. For example, one student commented that the roof is starting to fade. After a few minutes of allowing students to discuss amongst themselves, Educator 1 said, "All right, great observations! I'm holding up six fingers. See if I recall. I heard stone, brick, paint, metal, wood, rock. Did anyone say any other materials?" She asked the student to raise their hands and

Element: Built environment
Affordances: Create authenticity, Promote visual engagement, Spark curiosity, Prompt communication

she called them by their first name as written on their name tags. A student said concrete while another said wood tiles, to which Educator 1 exclaimed, "Wood tiles, very nice!". One student said arrows. She asked the student to reflect a little bit on his response by saying, "Arrows, there are arrows! Is that a symbol or an actual material?". After the student replied, she commented, "Yes, more of a symbol isn't it?". When a student mentioned timber, she added that "Very good! Timber, a very technical term other than wood." Then one student shared that her mom was talking to her that morning about "convict bricks". Educator 1 added that one of the convicts' hard labour tasks were to make bricks. She asked the same student, "So you think that this building might have bricks underneath the paint?" The last material a student pointed out was plastic. "Ahhh very good observation! So there actually is a plastic pipe there. That's a modern introduction to the building." During this short discussion, Educator 1 would walk from left to right along the empty space in front to get closer to the student who was talking.

Element: Built environment
Affordances: Prompt communication, Incite critical thinking, Create authenticity, Visual engagement
Deep learning: Cultivates a positive atmosphere that allow student to make and learn from their mistakes, Builds on students' prior knowledge and connects to new information

Element: Built environment
Affordances: Prompt communication, Promote visual engagement, Illustrate concept, Create authenticity
Deep learning: Cultivates a positive atmosphere that allow students to make and learn from their mistakes

Element: Macro spatial configuration
Affordance: Spatial flexibility

Educator 1 then walked over to one of three metal sculptures that was installed about a meter from of the stone barn's wall. All three sculptures are silhouettes - a dog and two humans who appear to be convicts going about their chores. "I also want to point out, that these structures made of metal", she paused and started tapping on the metal sculpture, "are not part of the building because I can walk behind them. So, ignore that. It's actually a sign so that people up there at the big homestead can get the idea that something's happening down here. To come down and visit. But for us today, it's not part of the building."

Element: Installed object
Affordances: Visual engagement, Illustrate concept, Create authenticity

She moved away from the sculpture and walked closer to the students. “Good observation about the materials involved in this building. It’s a little bit like you’re in first-year university studying history. Because what historians need to do at an important heritage or historical site like the homestead is to document all the buildings here. And I am going to show you the style of diagram that historians do to document very important old buildings.” She pulled out a laminated sheet of paper and started showing that to the students. “It’s scientific, it’s not art-y, there’s no clouds in the sky, no grass on the ground, or cow poo like there really is. It’s just a line drawing.”

Element: Carried object
Affordances: Visual engagement, Illustrate concept, Provide relevance
Deep learning: Provides connections with real world situations

She asked, “Who’s done a diagram before in school?” A few students raised their hands in response. “Fantastic!”, Educator 1 exclaimed. Still holding up the laminated sheet of paper, she continued to say, “These are called elevation drawings. And it’s what a historian does to document the building.” She took a deep breath, then added, “This drawing of this building”, she points to the stone barn, “was done about thirty years ago.”

Element: Carried object
Affordances: Visual engagement, Illustrate concept
Deep learning: Provides connections with real world situations, Builds on students’ prior knowledge and connects to new information

“We are looking at this part of the diagram”, she pointed to the wall in front of them then pointed to something on the laminated paper. “This part of the building now, there is a dotted line. Kind of suggesting that there must have been a door there but it’s only a dotted line, so, the historian didn’t really see a door there.” She pulled out another laminated sheet, this time showing a magnified section of another diagram. “I am just gonna enlarge that now, that diagram, because that’s the same part of the drawing and it’s the elevated section of this barn”. Then her voice changed a little

Element: Carried object, Built environment
Affordances: Visual engagement, Illustrate concept, Create authenticity

bit and she sounded a bit excited. "In thirty years, something has changed... on this building! The diagram's not right anymore." She called out one student's name and asked if he knows what has changed. However, the student, instead of answering her question, asked if they can go inside the building.	*Element:* Carried object, Built environment *Affordances:* Visual engagement, Prompt communication, Incite critical thinking, Create authenticity *Deep learning:* Engages students in active learning through open-ended questions
Educator 1 explained that they would but, "we will do some thinking and observing first about this building."	*Deep learning:* Brings out structure of topic/subject
She persisted in encouraging the students to figure out the changes that have happened on the building since the diagram was drawn. "What's changed about the roof?", she asked another student who shared her observation.	*Element:* Built environment *Affordances:* Prompt communication, Promote visual engagement, Incite critical thinking, Create authenticity *Deep learning:* Engages students in active learning through open-ended questions
"Well done! In the diagram thirty years ago, Emma noticed that the roof is flat. There is a roof there, it's just flat. Now, they have put a pitched roof back on to this building because the historians know that the scale of this building, the size of it, the materials it's made of, it didn't actually have a flat roof that collapsed at some point over the hundred and so years. So, the historians have rebuilt this roof. Now, we need to update this elevation drawing!"	*Element:* Built environment *Affordances:* Promote visual engagement, Create authenticity *Deep learning:* Provides connections with real world situations
She then informed the students that they were going to open up the tarpaulin mats, lay them out on the grass, sit down, open up their clipboard, and then "you are going to re-draw the view of this building that you can see today. And put the roof on!" She helped some students get settled and even provided a spare pencil to one student who lost his.	*Element:* Carried object, Built environment *Affordances:* Visual engagement, Create authenticity, Provide experiential learning *Deep learning:* Assesses learning through student's ability to demonstrate application of knowledge and skills by creating an output

A student asked what they are going to draw. "What you're going to draw is a simple diagram of the building you can see – the part of the building that you can see. You will draw a rectangle for this wall, a long rectangle inside the rectangle, and then you are going to draw a trapezium. She asked if anyone has previously encountered the shape trapezium in math. After commenting that their teacher is nodding, indicating that yes, the students have already learned about this shape in school, she described what a trapezium is. "A trapezium has a long line at the bottom", she again showed the diagram and pointed to this shape on the laminated page. "A shorter parallel line on top, shorter than the one on the bottom. And then you join the two lines up with lines going opposite directions." She continued to say that after the students are done drawing their rectangles and trapeziums, they are going to put labels on their diagram based on what they noticed that the building is made out of. She reminded them about their earlier discussion – that the wall is made of stone and the roof is made of timber shingles. She produced a few more laminated sheets to show students. This time they had the words "stone wall" and "timber shingle" printed on them, to assist those who had difficulty spelling the words.

Element: Carried object, Built environment
Affordances: Visual engagement, Create authenticity, Provide experiential learning
Deep learning: Builds on students' prior knowledge and connects to new information

Element: Carried object,
Affordances: Visual engagement, Illustrate concept

Element: Carried object, Built environment
Affordances: Visual engagement, Create authenticity, Provide experiential learning
Deep learning: Builds on students' prior knowledge and connects to new information, Assesses learning through student's ability to demonstrate application of knowledge and skills by creating an output

Element: Text
Affordance: Transmit information

In this section, I demonstrated how I analysed data from my observations by presenting a vignette for one Excursion into museums observation session. I added annotations to indicate elements of the learning environment, affordances of these elements, and deep learning strategies that one participant used while conducting the education program.

5.3 Summary

In this chapter, I outlined the design and methods of investigation employed for this study. The three findings chapters follow immediately. The first findings chapter focuses on places where museum educators taught student groups. The second findings chapter reports on the elements that the museum educators used and how they used these for teaching. The final findings chapter discusses how museum educators used the learning environment to support students' deep learning.

CHAPTER 6: PHYSICAL CONTEXT: PLACES FOR TEACHING

This is the first of three chapters where I report on what I gathered during my field observations and heard during the interviews. Finding presented in this chapter primarily came from program observations, excerpts from my research journal, and semi-structured interviews with participants. Additionally, I also used audio recordings of programs observed, teaching artefacts (i.e. worksheets and handouts during or after the program), photos I took of the learning environment and objects within. Entries from my research journal, the audio recordings, and photographs were critical resources that helped me in writing vignettes, or short descriptive accounts, included in this chapter.

As mentioned in the Research Design and Methods chapter (Chapter 5), I removed Case study 3 because efforts to recruit participants were unsuccessful. Hence, subsequent sections will only discuss two case studies.

Findings in this chapter answer this specific secondary research question:

> *Where do museum educators teach student groups, and what do these learning environments look like?*

As discussed in Chapter 2, this study takes a holistic view of the learning environment and acknowledges that it has physical, sociocultural, and personal dimensions. In the succeeding sections, I examine various spaces where participants conducted the museum programs I observed. This section is divided into two case studies, Excursion into museums and Incursion into schools. For each case study section, I start with a summary of the different types of learning environments then continue to provide descriptions of each type. I also included illustrations and photos to help the reader visualise the physical characteristics of the learning environments. I conclude this chapter with a discussion of key findings from the data presented in the chapter.

6.1 Excursion into Museums

All 29 program observations included in Excursion into museums case study were conducted, within the premises of the museum, for student groups by a person affiliated with the participating museum. **Table 6.1** enumerates and describes different areas within the museum's premises, where participants conducted programs.

Table 6.1.

Museum areas and frequency of use, Excursion into museums case study

Location	Description	Participants	Frequency of use
Museum classroom	An enclosed room that may or may not be connected to another classroom via moveable walls	Educator 1, Museum 1 Educator 3, Museum 3 Educator 6, Museum 4 Educator 7, Museum 4 Educator 8, Museum 4 Educator 10, Museum 5 Educator 14, Museum 5 Educator 17, Museum 6 Educator 25, Museum 9 Educator 26, Museum 9 Educator 27, Museum 9	17
Exhibition gallery	An enclosed space where the museum exhibition is displayed	Educator 2, Museum 2 Educator 3, Museum 3 Educator 4, Museum 3 Educator 5, Museum 3 Educator 6, Museum 4 Educator 9, Museum 5 Educator 12, Museum 5 Educator 13, Museum 5 Educator 16, Museum 6	12

Location	Description	Participants	Frequency of use
		Educator 18, Museum 6 Educator 24, Museum 9	
Multi-purpose gallery	A space that may be used for an exhibition or conducting an education program	Educator 9, Museum 5 Educator 11, Museum 5	3
Lobby	A large open space located just by the museum entrance that others refer to as atrium or foyer	Educator 3, Museum 3 Educator 4, Museum 3 Educator 5, Museum 3 Educator 16, Museum 6 Educator 18, Museum 6 Educator 24, Museum 9	6
Hallway	Thoroughfare between spaces such as classrooms or galleries	Educator 2, Museum 2 Educator 5, Museum 3 Educator 6, Museum 4	3
Theatre	A big room usually with permanent seating facing a stage used for lectures	Educator 4, Museum 3 Educator 5, Museum 3 Educator 17, Museum 6	3
Outdoors	Areas outside the museum building that are still part of the museum premises	Educator 1, Museum 1 Educator 5, Museum 3	4
Purpose-built venue	Parts of the museum that were specifically	Educator 14, Museum 5	2

Location	Description	Participants	Frequency of use
	built to accommodate a special purpose not common to other types of museums		
Historic building	An architectural structure preserved due to its historical or cultural significance	Educator 1, Museum 1	2
Elevator	An enclosed platform that takes visitors up or down to various museum levels	Educator 16, Museum 6 Educator 3, Museum 3	2

The frequency of use adds up to more than 29 because some programs were held in more than one location since some participants moved from one area of the museum to another while teaching. The frequency count denotes the cumulative number of times participants used that type of environment throughout the duration of the program they were teaching.

Figure 6.1 provides a visual representation of the percentage distribution of areas within the museum that participants used as a venue to teach the whole or part of an education program.

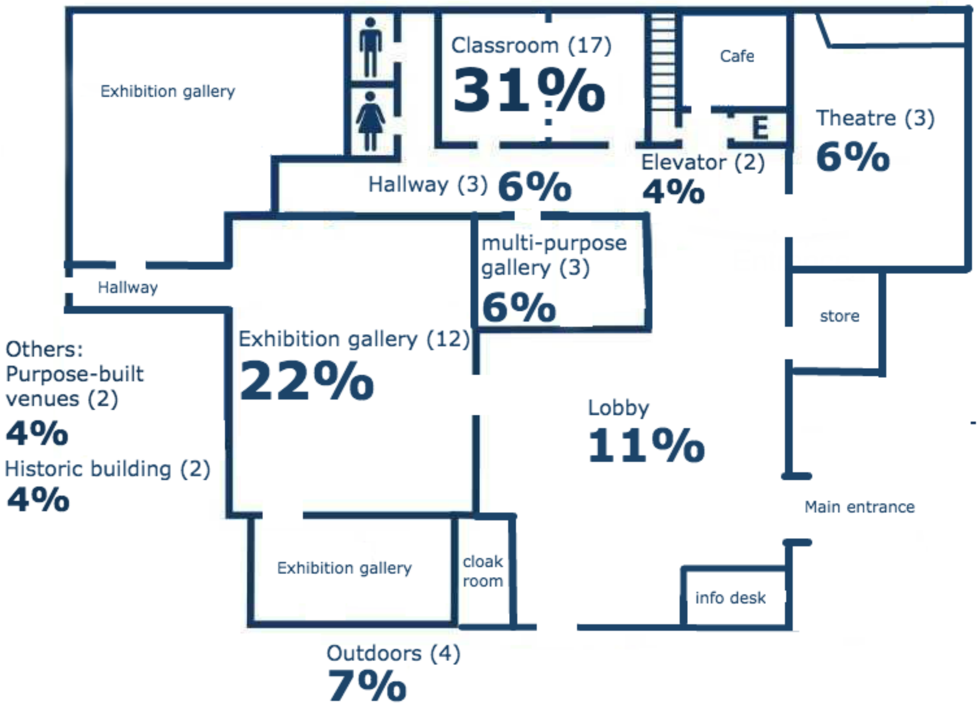


Figure 6.1. Percentage distribution of museum areas used, Excursion into museums case study

I am now going to discuss different types of learning environments enumerated above. In this section, I describe in more detail museum classrooms and exhibition galleries as these two learning environments combined represented more than half of where participants taught students.

6.1.1 Museum classroom.

As can be seen from **Figure 6.1**, the most commonly used space for teaching in a museum was inside a classroom (31%). Dovey and Fisher's (2014) definition of a classroom as a learning space that can be fully closed off from other spaces with the capacity to accommodate between 20 to 30 students generally applies to schools. That same definition remains appropriate in describing classrooms inside museums that participants used in this study. I find it interesting that more than half of the programs I observed, or parts of it, were held inside a classroom. It is a common assumption that schools take their students on a field trip into museums to get them out of the classroom. Yet students are predominantly being taught in classrooms as part of the museum programs.

Eleven programs were conducted entirely inside a museum classroom. However, it may well be that the only characteristic these museum classrooms share with their school counterparts is that it can be enclosed and separated from other spaces. I will elaborate on this further in the discussion section of this chapter.

It is worth noting that these classrooms were shared spaces and not assigned permanently to one particular museum educator or program. Participants across all the programs I observed had to personally set-up the classroom before the program then return it to its "original" condition afterwards. Educator 8 talked about packing up the room after her session and how the museum used the classrooms for different programs and even birthday parties:

> *It gets used for everything. So this space, we change it from dinosaurs to a lesson about habitats and adaptations so this wall would be closed. The other side of the room would open up and there's different embedment of insects there, spiders, birds, so we change the whole room around. So this room after the session, I'd pack away, so it's just an empty room so it's ready for the next session with whoever's running it. So there's posters ready to put up, there's all the different activity boxes with the different activities prepared. But then the walls can also come down. So, for school holidays, this space becomes bigger and it can actually open up so the general public can access it from the front over there. So, these side doors are sort of just left closed. So, it's very versatile. On the weekends, it's used for birthday parties as well, so not just education spaces… Yes, just on Saturdays but they're dinosaur-themed. So, we kind of use a few of the resources here today for the dinosaur parties as well. (Educator 8, Museum 4)*

Educator 8 added that sometimes other staff members helped her set up the classroom based on what she already envisioned the room to look like for her activity:

> *This morning, it took me just under an hour. I had a bit of help with… from one of the other ladies who work here but it took about 45 minutes or 50*

minutes to set up but I did have an idea of what I wanted the room to look like already. (Educator 8, Museum 4)

She also said that she would adjust the set-up depending on the age group of the students she was teaching:

If it was a younger group like kindergarten or pre-school, we wouldn't have this sort of Centrosaurus. They'd be more play-based. The play area... we'd have a larger sort of play area. And even though the content, the way it is sort of spoken about would be different. It would be more following the story of a palaeontologist rather than... (Educator 8, Museum 4)

Educator 6, another participant from Museum 4, said that it took her half an hour to set-up the classroom for the one-hour program that I observed her teach. She added that sometimes they would leave the classroom already set-up for a few days when they were teaching the same program throughout the week:

Yes, but the Biota today is a full day so we always would try to have four sessions booked and then the schools have a take between the two sessions here or the gardens. So we set up in the morning and it's set for the whole day. And generally, because it's an intensive program, it's just a run in through terms two and three. We'll set up on a Monday and as long as there's nothing else happening in the evening, we can leave it like that during the week. (Educator 6, Museum 4)

Setting up the classroom sometimes entailed putting up textual and photographic displays on the walls; taking out from storage museum objects, specimens, and artefacts; arranging furniture such as chairs, tables, and writing boards; preparing computers, tablets, projectors, and other technological devices; or laying out the art materials and worksheets. Part of preparing the room was determining the physical arrangement of the classroom and where or how students will sit while taking into consideration the qualities of the room itself. Educator 6, explained:

I find definitely the room itself could do with better lighting and I'm often setting up the where the groups are sitting depending on which lights are working or where they're situated. We don't have very good lighting in there. But we do have the flexibility for a small group to set up less stations and for a large group to have replicas, so I think that works really well. (Educator 6, Museum 4)

In some museums, these classrooms were not only used for teaching school groups or as a venue for education programs but were also used as a shared space among various museum departments and made available for other purposes. At Museum 4, for example, Educator 6 continued to tell me about how they are able to empty out the classrooms so that it may be used for activities that are not necessarily part of the museum's education programs:

Sometimes we might get to - always on a Friday generally - we'll pack everything away. So there's cupboards on the side walls and all the boxes get locked away and all of the animals, as I said, get shared with the next room so they'll get taken into the storeroom. We have the capacity to wheel all of the cupboards out, we can move all of the seats and benches out. Generally, those two big megafaunas - the giant kangaroo and the big tapir stay in that room but because they're on wheels, we can move them out. Because in that room we also have the tea parties. (Educator 6, Museum 4)

She said that the classroom is really a multi-purpose room for the whole museum and not just for the Education Department:

Absolutely! Sometimes there's meetings in there, sometimes there might be a different program. We do aboriginal art programs and you need a big space. We can open the divider between that room and the next learning space to make a giant room. In the school holidays, everything's packed away and that's opened up and there's craft activities and things… So it's a really flexible space. The cupboard at the end has the big bird and kangaroo and that closes - those doors - so that protects those objects if you have *something else in the room. If it's a birthday party or something, they often like to leave those giant megafaunas in it. It's really cool! But the wall, you would have noticed the materials, all of the posters and the information goes up there. We take all of those down as well so they can change that. (Educator 6, Museum 4)*

Educator 7 talked further about the flexibility of the classrooms for use in activities that are not just for school groups. She explained that the museum was able to use the rooms for other activities because of its flexible qualities. The room can be combined to create one big room, or the walls can be closed so that there are two smaller rooms. She added that the rooms were even used for performances or yoga classes.

So, I mean, I guess you could classify them as education programs for the more public – for the members of the public, so public programs. But also, for example, we've got a new exhibition that we'll be opening this month. And it's sponsored by an external corporation, and for the first week, there will be a coffee cart that will be open in that space. We'll open up like the door... make it look like it's a roof that will actually open up. I don't know if you realized that you can open it up into one massive space. It's extremely flexible. So not only to the two classrooms... not only can turn you that enclosed room into one massive space, you can open the whole space up, so it's really flexible... It's multi-functional – like it can be used up in venues in museum sometimes, not frequently. Yeah, yeah. Or sometimes for performance, when there's like a performance, like a meditation program that's happening in one those spaces in a few weeks, on the weekends so it's multi-purpose. (Educator 7, Museum 4)

I noticed the absence of conventional student chairs and desks in many of these classrooms. While some museums did have chairs and tables inside their classrooms, in majority of the programs I observed, students were seated on the floor or allowed to choose where to sit and what form of seat to use depending on what was available in the room (i.e. chair, stool, bean bag, ottoman, exercise ball, cushion, carpet squares, wobble chairs). For instance, Educator 1 chose to have students sit on the carpeted floor of the classroom despite the availability of chairs as can be seen from **Figure 6.2**.

Figure 6.2. Museum classroom set-up and used by Educator 1.

I asked Educator 7 why she decided not to use tables and chairs for her program:

> *Well, I think, it wasn't like a conscious decision except for – and because there were tables used for when they make a fossil and I think, too many tables could kinda get cramped... And where I would like to give them the opportunity to sit down in their groups and feel relaxed. And sometimes sitting all the time all day, and the students, you know. Yeah, I quite like that kind of informal, relaxed approach." (Educator 7, Museum 4)*

Educator 7's response indicated that participants took into consideration the kinds of activities they were going to do in class as well as students' comfort when they select and set-up the venue of the program. She hinted that she deliberately made decisions on how to arrange the room and furniture to encourage students to work together.

However, there are two exceptions to museum educators opting not to use the chairs and tables that were already in the venue. The first one was in one of the classrooms at Museum 5, which Educator 10 used as the venue for part of the

‘Robots: Robot and machines’ education program for schools. The classroom was set-up like a computer laboratory with desktop computers sitting on top of tables clustered into two groups on each side of the room. Each student was seated on a black swivel chair, such as those that you would normally see in offices. Another exception was a classroom at Museum 6, where a Chinese painting and calligraphy workshop was facilitated by Educator 17. This classroom had two rectangular tables that were pushed together to create a larger square table. There were six of these adjoining tables evenly spread across the room. Six or seven students were seated on chairs around each of these tables. The sinks on one side of the room and the multitude of art equipment and materials gave me the impression that this room was regularly used for art workshops.

6.1.2 Exhibition galleries.

Participants also used exhibition galleries (22%) as venues for conducting programs for students. This provided an excellent opportunity for them to use the exhibition and many of the objects installed within the gallery in engaging with students. In the next chapter, Pedagogies of the learning environment, I discuss in more detail various ways participants used objects and spaces within an exhibition for teaching.

Unlike classrooms, other learning environments in the museum, such as exhibition galleries, lobbies, hallways, and outdoor areas were available for public use. When participants were using these spaces for teaching, there were other museum visitors, even other student groups, who were also using the space. Hence, aside from finding available spots where they can gather students, they also had to negotiate with other users in sharing the area. Some participants, such as Educator 18 from Museum 6, appeared to have become quite adept at creating small pockets of learning environments within the exhibition galleries for her school groups.

Vignette 2: Pockets and corners

Shortly before ten am on a Wednesday morning, a group of primary students entered through the Schools and North Entrance of Museum 6.

Their school teacher instructed them to deposit their bags in the cloakroom. Those who were finished returned to the small lobby just by the doors and were being sorted by their teacher into several groups. As this was happening, another group of students entered the museum. Like the first group, they also deposited their bags in the cloakroom. This group, however, was doing a self-guided tour so they went ahead and continued towards the galleries after exiting the cloakroom.

I noticed that Educator 18 was standing in front of the information counter with four other museum educators. As soon as the teacher finished assigning students into groups, Educator 18 walked over to her group. After a brief greeting, she asked students in her group to each get a folding stool from the storage room. After everyone has obtained a stool, Educator 18 asked one student to help her demonstrate how and how not to carry the chairs – reminding them to be careful and avoid hitting other people or objects in the galleries. Then she led the group, comprised of 16 students, up to level one and into the Japan Gallery. She stopped just by the entrance, in the open space right in front of a display of containing a samurai armour and a screen, told her students to sit facing the display, and stood quietly on the right side of the display. When all the students have settled in their stools and before starting with the program, she again reminded students to be considerate of other museum visitors by minimising their noise.

Figure 6.3. An area of the Japanese Gallery that Educator 18 used

The vignette above, *Pockets and corners,* demonstrated how Educator 18 also took into consideration the availability of space and other circumstances (i.e. presence of other students) in directing where she brought her student. During the interview, I asked Educator 18 whether she chose that spot because it was, as she described, a quiet space, or because those two exhibition objects were integral to the program. Her response indicated that the location was chosen because of the positions of the objects as well as the need for a space that is conducive to learning for her students:

> *Often it will be a place where there is something, where you know, there's a number of things. A place that you know will have an object that is engaging but also where there is that quiet space that you can work to establish quite quickly what students know, what level they are at, and what their kind of group culture is. (Educator 18, Museum 6)*

She continued to say that she normally opted to start her sessions in a relatively quiet spot with just a few engaging objects since too many other objects may prove to be distracting for students. However, she went on to add that she also took cues from students and objects that capture their attention, indicating that these programs not completely teacher-led:

It is always making those decisions as you go, but there are sometimes, I'm not sure if whether we stopped at that group and looked at those Mexican ball playing figures. For example, those things are on a quite inconvenient location that they do have lots of traffic going past. But they do have quite engaging stories, that sometimes with some groups, because it does make that connection between the past and the present, that you kind of make the choice to stop there even though sometimes it is a bit noisy or high traffic area. But as a starting point, it would be something that you wouldn't necessarily choose as a starting point. You choose that once you have kind of established a kind of group culture, I suppose." (Educator 18, Museum 6)

Educator 18 also called on students' spatial awareness by encouraging them to be mindful of their surroundings and how their movements could affect other visitors and objects in the museum. The museum educators who were involved in designing the museum's programs demonstrated some spatial awareness in their choice of furniture for use by students inside the galleries. The museum used a lightweight and folding stool that students can carry in one shoulder. When folded, these stools hardly took up any space making it easy to store when not in use and allowed students to navigate through the galleries effortlessly.

Other participants also displayed this intentional selection of small learning environments. For example, Educator 3 explained how her decisions on which areas in the gallery she brought students depended on gallery lighting, proximity to a relevant exhibition object and viability for a place where students can sit down. She also mentioned that she would choose locations that do not impede other people's use of the museum.

We have our vantage points. Looking right, you've already scanned, this is a great place to sit kids down. It's not blocking any stairways, it's got lighting. It's off to the side but we're close to an exhibit. So once they listen to the introduction then we can get up and walk to that actual glass to explain. (Educator 3, Museum 3)

Another factor that participants considered were the acoustic quality of the gallery. At Museum 3, for example, Educator 4 told me that the exhibition galleries tended to produce a lot of echoes, which made teaching a group of students a bit challenging.

The acoustics are very difficult. This is one reason why, you know, there are limits to the size of the group that you could have in those galleries. The building itself is a self-limiting factor so we would tend to have our larger groups generally in here in the education rooms. (Educator 4, Museum 3)

The museum found an unconventional way to overcome this acoustical challenge. At some point, Museum 3 even hired a theatre performer to conduct voice training for the museum educators as well as assist in identifying areas within the gallery that may be suitable for group discussions. Educator 4 added:

One other thing I would just say about the galleries, it's really hard to find gathering spots for groups of children in this building, it's a significant issue. So, we have had voice training and gone around the galleries and gone 'so this is a slightly better spot'. The acoustics, the levels of the roof, the cases reflect so when I stand, I'll often stand so that the sound travels along the case, I hope. (Educator 4, Museum 3)

She further elaborated on the training they received and how else they applied it when they conduct programs in the museum. The training also helped her with a variety of techniques to keep the delivery of her programs more exciting and engage students in more active learning. One of the techniques she used was running the programs like a talk-show where she asked a lot of questions. Her colleagues, on the other hand, engaged students through role-playing and theatre-like actions. She hinted at making her sessions more light-hearted by encouraging her students to pretend to take photos with a camera that does not actually work.

Yes, yes, so we had some training uh maybe 18 months ago now and from an actor who has worked in museums and he has talked about the variety *methods that you can use to create anticipation and to mix it up a bit. So, it's not just presentation because, it is a presentation but what can you do then to make it active, active learning as oppose to that passive learning. For example, some people say I asked a lot of questions and that it's bit like a talk show. What my colleagues do is a little roleplay and get children up and so at that point it has been like a piece of theatre. I like getting the kids out uhm to take a photo. I know I'm teasing them at that point. But I don't think its setting them up to fail that I'm teasing it's an "ohh he's learning, okay, one point forward!". (Educator 4, Museum 3)*

6.1.3 Multi-purpose gallery

In Museum 5, they had what appeared to be both an exhibition gallery and an education program venue. To maintain the anonymity of this participating institution I will call this venue *The Lab*. I observed three different programs led by two participants there. Two of these programs were taught completely at *The Lab*, which was located at the junction between the education classrooms and the exhibition galleries. Perhaps that is why its duality in purpose suited its location. The characteristic that sets it apart from the other classrooms in Museum 5 is that it looked like this could not be easily converted into an enclosed space as it did not provisions for doing so (i.e. moveable walls). Five per cent of teaching across various Excursion into museums case study sessions occurred in this kind of learning environment, which I classified as a multi-purpose gallery.

Several Museum 5 education staff explained to me that *The Lab* was a relatively new and experimental venue designed to accommodate a diverse set of education programs. However, when it was not being used for teaching, it had technology-based interactive activities that museum visitors can use. *The Lab* is described in Museum 5's website as a hands-on, immersive multimedia space where visitors can explore and learn more about digital technologies. It seemed like a versatile space capable of accommodating programs with varying teaching approaches, spatial needs, and learning area foci. Two of the programs I observed at *The Lab* were centred on science and technology while the third was focused on history. I witnessed this space transformed to host a role-playing history program on the Australian Gold Rush as well as an interactive visual computer coding class.

6.1.4 Museum lobby

Student groups were often met by the participants in the museum lobby or a designated school group gathering point such as the one I mentioned earlier at Museum 6. Many of the participants generally waited until all students were inside the classroom or gallery before starting the introduction. However, there were a few times (11%) when participants used the lobby as one of their learning environments, either in the beginning or on their way to another part of the museum. I use the term 'lobby' to refer to the big open spaces that usually welcome museum visitors as they enter the building. Some museums call this type of areas an atrium or foyer.

When participants used the lobby at the start of the program, the discussions were usually centred on providing students with background information about the museum, location of facilities, instructions on what to do during emergencies, and finally, an introduction about the program so students know what to expect. One participant, Educator 24 from Museum 9, facilitated an in-gallery school program on the exhibition "Gallipoli: The scale of our war" for a group of 19 primary school students. She took advantage of the wide, empty, and open space in the museum's lobby to start the discussion with students. The gallery for this particular exhibition predominantly had tight spaces and narrow hallways that were typically full of other museum visitors. This gallery's spatial configuration made it even harder for Educator 24 to find spots to gather students for group discussions or for her voice to be heard above voices of other visitors talking, background music, audio from videos, sound effects, and narration coming from the exhibition. She, in fact, constantly reminded students to be mindful of the other visitors or to let other people through. In areas where space was constricted, she usually drew her students close around her and positioned herself somewhere in the middle of the group while they view an exhibition display together. Other times, she would have the group discussion prior to entering or after leaving crowded or tight sections of the gallery.

6.1.5 Theatre

Popular exhibitions, such as the Gallipoli at Museum 9, usually resulted in overcrowded galleries. This, in turn, inhibited the gallery from being an ideal venue for holding programs for student groups. According to Educator 17, a participant from Museum 6, when the museum had its exhibition "Hokusai" last year, they decided that all school programs organised in conjunction with the exhibition would not be held inside the gallery. Educator 17, who facilitated the Hokusai Introductory Talk and Walk-through for a group of 25 secondary students, explained further:

> *A number of people say that with these paid exhibitions that are usually quite popular, it's quite problematic to take groups in. I know, for example for the Van Gogh exhibition, that was cancelled. It was too problematic. So we try to work with the general public in using the space along with the students. Yeah well, we don't take school groups through on really popular exhibitions. (Educator 17, Museum 6)*

Instead, school group activities were held elsewhere in the museum. The 45-minute Introductory Talk component of the program was held inside a theatre, where Educator 17 relied almost exclusively on images projected on a screen from Liquid-Crystal Display (LCD) projector. After this, students were ushered into the gallery where they explored the exhibition on their own but already equipped with relevant information from the preceding discussion.

Another reason why education programs, or parts of it, were held inside museum theatres is that these spaces can simultaneously accommodate large numbers of students. In particular, Educator 5's program at the Museum 3, had 81 students. Below is another excerpt from my research journal briefly describing the session in the theatre of Museum 3.

A large group of students gathered on one corner of Museum 3's Gandel Atrium, close to the floor-to-ceiling windows framing a tranquil view of Burley Griffin Lake. It was two in the afternoon. The afternoon sun passing through intersecting metal beams supporting the glass panes was casting overlapping shadows onto the floor, students' faces, and a long, cushioned, ochre bench positioned just by the wall. I counted the students. There were 81 of them, all from one primary school. Educator 5 welcomed the group to the museum. She also gave them an overview of the program. This lasted for a mere couple of minutes and before long they formed two lines then started walking towards Visions Theatre.

The theatre can seat 177 people. It has a low stage in front where the lectern stands. From 207 p.m. to 223 p.m., Educator 5 conducted the program from this stage making use of the microphone attached to the lectern. She occasionally walked over to an old suitcase which was sitting at the centre of the stage. This theatre seems to have very good acoustics as I could hear students' responses to Educator 5's questions even though students were not using a microphone. On a screen installed at the back wall of the stage, she showed six different images using a screen and an LCD projector installed in the theatre. After this, students were divided into smaller groups. Other museum educators led the groups away while Educator 5 took hers, composed of 22 students, into the gallery to continue the program.

6.1.6 Other areas used for teaching

In addition to traditional venues for on-site museum programs such as classrooms (31%), exhibition galleries (22%), lobbies (11%), and theatres (6%), there were also other areas within the museums that were not intended as teaching spaces but were nevertheless used as such by participants. One area, the museum lobby, has already been discussed earlier. Other areas include the outdoors (7%), hallways (6%), purpose-built structures (4%) such as a planetarium and telescope dome, historic building (4%), and even inside elevators (4%). Hallways and elevators were unusual places for teaching.

Participants who continued teaching while walking with students between locations were usually answering questions from them about the last topic they discussed. Sometimes they were answering questions and providing information about objects displayed along the hallway that caught students' attention. In the case of Educator 16, another participant from Museum 6, he used the time during the elevator ride from the ground level to level two of the museum in preparing students for the next gallery they were visiting. He told them that they were going inside a gallery that showcased 19th century Australian Art and were going look at a few important pieces in the museum's collection.

6.2 Incursion into Schools

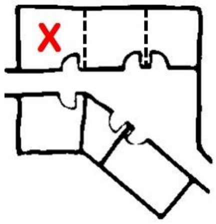
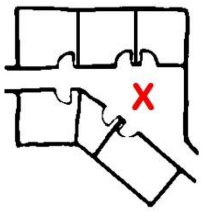
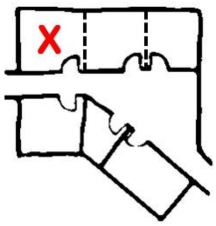
All 13 programs included in the Incursion into school case study were conducted for student groups. However, only 12 of these programs were held within the requesting school's premises. One of the programs was held in a community centre.

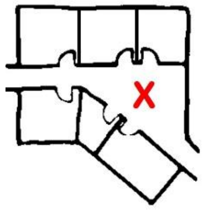
Table 6.2 presents a breakdown of the various places where each participant conducted Incursion programs. Where applicable, Dovey and Fisher's (2014) typology of learning spaces in schools is used. An X marks the specific location where the activity was held.

Table 6.2.

School areas used, Incursion into schools case study

Participant	Location of program	Description of learning environment	Typology of learning spaces
Educator 19, Museum 6	School	Multi-purpose room not connected to any classroom and located in a separate building	Not applicable
Educator 19, Museum 6	School	Designated art classroom connected	Type C

Participant	Location of program	Description of learning environment	Typology of learning spaces
Educator 19, Museum 6	School	to another classroom via an accordion-type wall that creates a bigger room when opened	
Educator 20, Museum 7	School	Multi-purpose room not directly connected to any classroom but located in the same building	Not applicable
Educator 20, Museum 7	School		
Educator 23, Museum 8	School	Shared space of several traditional classrooms	Streetspace 
Educator 23, Museum 8	School		
Educator 23, Museum 8	School		
Educator 21, Museum 8	Community multi-purpose building	Multi-purpose room and exhibition gallery	Not applicable
Educator 22, Museum 8 1	School	Classroom connected to another classroom via an accordion-type wall that creates a bigger room when opened.	Type C 
Educator 22, Museum 8	School		
Educator 22, Museum 8	School	Streetspace of Type B classrooms	Streetspace

Participant	Location of program	Description of learning environment	Typology of learning spaces
Educator 22, Museum 8	School		

As can be seen from **Figure 6.4**, four different kinds of learning environments were used by the participants. It is worth noting that all the participants did not choose the venue for their programs. These were selected for them either by the schools (92%) or the community centre (8%). Furthermore, none of them had seen or used these venues prior to their scheduled program.

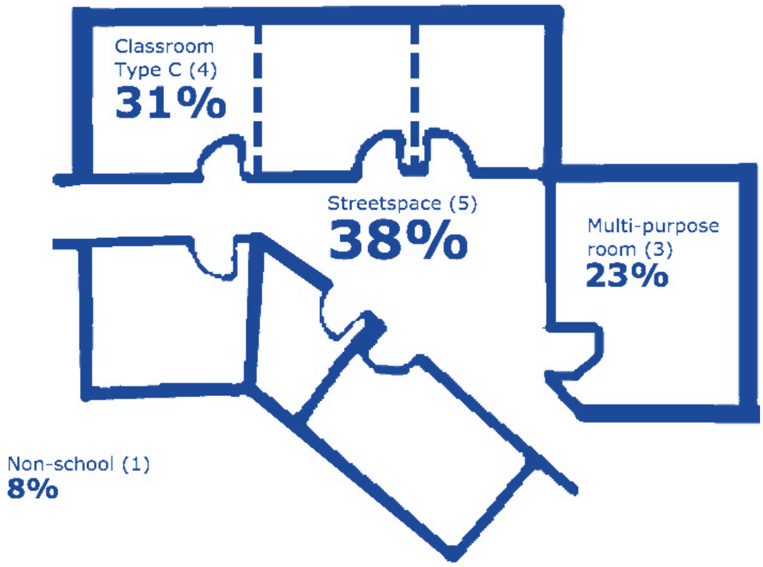


Figure 6.4. Percentage distribution of school spaces used, Incursion into schools case study

I will now describe the details of the four different learning environments while also mentioning their relationship with other spaces nearby.

6.2.1 Streetspace

Five programs (38%) were held in two schools that appeared to have Type B[6] classrooms. However, the programs were not held inside classrooms but in what Dovey and Fisher (2014) call a ‘streetspace’, an open learning space that cannot be closed off and generally serves as the main thoroughfare to the other classrooms. Educator 23 from Museum 8 facilitated three different groups of students in this kind of space. When she arrived at the venue, all the chairs and tables were pushed toward the walls. She took some Monoblock chairs and ottomans then arranged these in a circle at the centre of the space. When students arrived, they chose where to sit among these seats.

Figure 6.5. The streetspace used by Educator 23

[6] Dovey and Fisher (2014) describe Type B classrooms as identical to traditional cellular classrooms except that instead of being accessed from a narrow corridor, these classrooms open into what the authors called a ‘streetspace’.

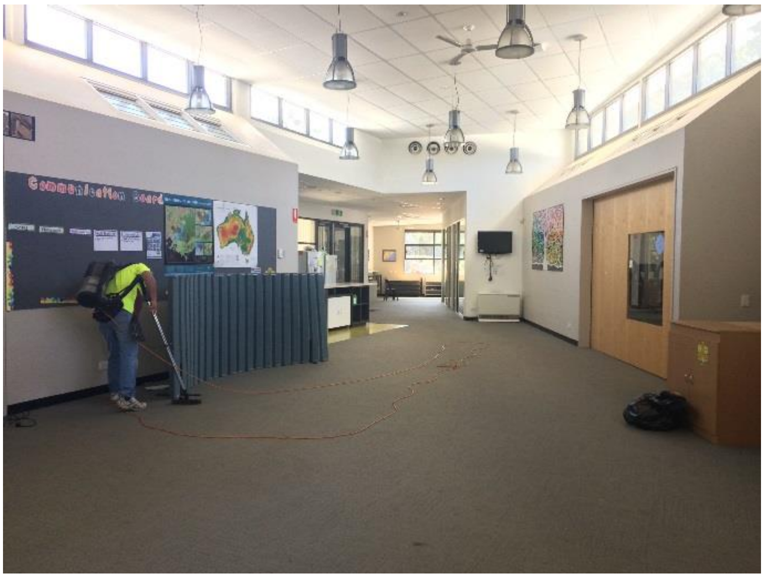


Figure 6.6. The other end of the streetspace used by Educator 23

During the interview, I asked Educator 23 if she typically requests from the school a particular type of space for her to use:

> *Yes, I usually request and that are they in… if I'm doing multiple sessions, that I'm in one location, so that I don't have to pack up and move around. And that usually means then that I'm in a shared space like a library or you know, like that big multi-purpose area. And then, I usually just wait to see. Each school has quite different ways to deal with it. Some kids are happy to sit on the floor, some are not. And so I just look at what resources are around and sort of just prepare it based on each different school. (Educator 23, Museum 8)*

Educator 22 also conducted two of his programs on this type of space. However, the streetspace where Educator 22 was assigned had a permanent stage integrated into the venue. He used the back wall of the stage as a makeshift screen to project images from the LCD projector that was hanging from the ceiling. As I did not see any pull-down or portable screen around, it is possible that this wall was intended to be used as the make-shift screen. This space had a sound system with microphones and speakers, which Educator 22 used during his sessions. Educator 22 asked students to sit on the carpeted floor in front of the stage when they arrived although there were some cushioned benches along the streetspace. It is important to mention that both Educator 23 and Educator 22 were from Museum 8, and they were teaching the same program to different student groups from different schools.

Figure 6.7. Part of the streetspace with a stage

6.2.2 Type C classroom

Four programs (31%) were held inside classrooms. These classrooms appeared to fall under Dovey and Fisher's Type C classroom or what the authors also call "convertible classrooms" (2014, p. 54). They defined Type C classroom as learning spaces with flexible walls that allow two traditional classrooms to be combined and become a bigger classroom or a shared space (Dovey and Fisher, 2014).

Two of Educator 19's programs were held in this type of learning space. The programs were conducted consecutively and in the same classroom, which seemed to be designated as a visual art classroom where students only go to for their art classes. I include below an excerpt from my research journal describing the room used by Educator 19.

> *The room was filled with two-dimensional and three-dimensional works of art such as whimsically painted guitars, shoes, and chairs. These were displayed on top of waist-high wooden counters that also doubled as storage for art supplies. There were landscape paintings waiting to dry and*

paintbrushes in coffee cups sitting on top of the long stainless-steel sink situated along one side of the room. Abstract art portraits and still-life drawings were hanging from bulletin boards and a lattice display screen. In the middle of the room were two clusters of wide tables with chairs around them.

Figures 6.8 and 6.9. Corners of the classroom used by Educator 19

I had the impression that the school purposely selected this room specifically because the program taught by Educator 19 from Museum 6, had an art focus. As a result, Educator 19 did not have to substantially rearrange the room to suit her needs. She, however, moved one of the tables to the front of the room and another one to the right side of the room. On these two tables, Educator 19 laid out supplies for the program.

The other two programs that Educator 22 taught were also held in separate Type C classrooms. However, unlike the classroom assigned to Educator 19, it seemed that the classrooms he used were not discipline-specific but were classrooms where students generally stay during class hours. Below is a brief description of the two classrooms drawn from my research journal.

Both rooms had typical classroom furniture such as individual student desks with an attached chair, bookshelves, open storage for students' belongings, carts with art materials, a wall-mounted whiteboard, a whiteboard with wheels. The teachers of these classrooms cleared a space on one side of the room for Educator 22 to use during the program. Students sat on the carpeted floor throughout the program.

In these two programs, Educator 22 moved from classroom to classroom. He set-up his space in the first classroom, conducted the program then packed up all his materials and equipment, relocated to the other classroom, set-up again and then conducted the same activity for students in that second classroom. This was unlike all the other programs in this case study where students proceeded to a single location where the participating museum educators had already set-up his or her 'teaching space'.

6.2.3 Multi-purpose room

Three programs (23%) were held inside multi-purpose rooms of the requesting schools. The multi-purpose room where Educator 19 conducted one other program was in a building separate from where the classrooms were located. On the other hand, the multi-purpose room where Educator 20 from Museum 7, taught his programs had doors leading to the school corridors. It seemed that both these rooms were not used as a classroom for a single class but were instead multi-purpose venues used for various school activities. Below is an excerpt from my research journal narrating part of what happened in Educator 20's session.

> *The multi-purpose room that Educator 19 used was a rectangular room with what appears to be an adjoining storage room containing shelves with clear boxes labelled from grades one to six, some board games, and several musical instruments. The room's sound system and microphone were also inside the storage room. When Educator 19 arrived in the room, the floor was empty except for some cushioned stools (ottomans) and a few padded long benches positioned along the walls. There were no chairs or tables in the storage room. She, therefore, decided that students will just have to sit down on the floor during the activity. However, she noticed that the floors were dirty. This prompted her to borrow a mop from the school and then she proceeded with mopping the whole room. Since she required a few tables to lay-out the various materials that will be used for the program, she and her assistant educator borrowed and carried some from the school library*

located across the courtyard. I even helped them return these tables to the library after the program concluded.

Figure 6.10. The multi-purpose room used by Educator 19

Figure 6.11. Tables borrowed from the library

The excerpt above demonstrated that Educator 19 did not rely solely on using what were inside the venue assigned to her. She took it upon herself to find from within the school other things, such as the tables and mops, that she needed in teaching her museum program. She also demonstrated that she considered students' well-being when she cleaned the floor herself because it was dirty and students were going to sit on it.

The multi-purpose room where Educator 20 conducted two consecutive programs appeared to be used for activities in visual art, performing, art and music as hinted by the numerous materials for these art forms stored in different corners of the room. Below is a description of this venue drawn from my research journal.

> *Artworks, information posters, and textual prompts were displayed on bulletin boards. There were also some artworks attached to the horizontal steel beams on the ceiling. On one side of the room were chairs stacked on top of each other. A drum set and a guitar inside its case were pushed into one corner. The room barely had any furniture. However, there was some computer equipment set-up inside a cabinet, and a few audio speakers were installed around the room. Educator 20 positioned the inflatable dome at the centre of the largely empty room.*

Except for when Educator 20 introduced himself to students at the very start, all the activities for his programs were held inside the dome. He did not use other sections of the room. During the interview, Educator 20 commented that he would have preferred if the space allocated by the school had a slightly higher ceiling. He added that schools are always informed in advance about the spatial requirements of the program. The inflatable dome, which is the centrepiece of the program, needed to be in a space that allowed it to be fully inflated. Otherwise, images projected on the dome could be distorted. He added that, sometimes, the spaces he was allowed to use did not match the required dimensions, but he just had to adjust and made things work. In this case, however, the ceiling was just about right, and he was able to inflate the dome enough to avoid image distortion.

Figure 6.12. The dome inside the multi-purpose room Educator 20 used

Figures 6.13 and 6.14. Chairs, performance and visual art materials, and musical instruments stored in the multi-purpose room

6.2.4 Community centre outside the school

Finally, one program (8%) in this study was held neither in a museum nor a school but in a community centre. This program was developed in conjunction with Museum 8's travelling exhibition and was then set-up in a community centre. A school group from a nearby town requested the program to complement their visit to the exhibition. The education program was held in one of the multi-purpose rooms within the community centre. When Educator 21 arrived, the room already had chairs arranged in a semi-circle facing the ‘front’ of the room where two tables were set-up. On these two tables, she laid out materials for the activity. Since the exhibition was located within the same building, Educator 21 had an opportunity to bring students to the exhibition, viewed the exhibition with them, continued the discussion, as well as answered their questions about World War I, the exhibition, and other related topics.

Educator 21 is the only participant whose program was held outside of the requesting school’s premises. Another aspect which sets this apart from the rest of Incursion into schools case study is that Educator 21 and the school group were both ‘visitors’ to the learning environment used for the program. While all participants have never been to or taught in the spaces assigned to them, this particular program had the distinction of both participant and students using an unfamiliar learning environment. She was also the only participant for this case study who used more than one space in conducting a program for a single group of students. Lastly, when she took the students to the exhibition, there were other visitors in the gallery. Hence, they had to “share” their learning space with other people who were not part of their group. In contrast, all the other programs in this case study were held in a ‘private’ space, where participants and the students they were teaching were the sole users of the learning environment throughout the session.

Figure 6.15. The multi-purpose room of the Longwood Community Centre

Figure 4.16 and 4.17. Exhibition installed at the Longwood Community Centre

6.3 Discussion

Findings presented in this chapter respond to this secondary research question:

> *Where do museum educators teach student groups and what do these learning environments look like?*

In the preceding sections, I presented five different types of learning environments where participants facilitated learning activities for students in Excursion into museums. For Incursions into schools, I discussed four different types of learning environments. I also described how these learning spaces looked like.

Data from this study showed that regardless of whether the sessions were held within the museum's premises (excursions) or outside (incursions), all of the participants taught in shared areas. None of the participants, both in excursion and incursions, had their own classroom or exclusive learning environment. In cases where participants used dedicated venues used for groups, such as museum classrooms or learning laboratories, they still shared the area with fellow museum educators who also utilised the same location in conducting their own programs. Despite not having a place for their exclusive use, participants appeared capable of curating their learning environment to suit the activity they were scheduled to conduct. This ability was consistently demonstrated by a majority of the participants.

There appeared to be three classifications of learning environments where participants taught:

- Purposely-built teaching areas such as theatres and classrooms both in schools and museums;
- Public learning places such as museum galleries and streetspaces in schools; and
- Incidental teaching areas such as museum lobbies, elevators, hallways, and outdoor spaces.

In the subsequent section, I discuss purposely-built teaching areas and public learning places. I will not go into detail about incidental teaching areas because participants spent very little time in these.

6.3.1 Purposely-built teaching areas

Data from observations and interviews indicated that it was a common practice among participants that they returned the learning environment into its "neutral" condition. Tables, chairs, equipment, artefacts, artworks, and other teaching/learning materials were put away and stored after they finished their session unless a subsequent session also had the same program. This practice seemed to be institutionally established and allowed the next user of the learning environment to also curate it based on their pedagogical requirements.

However, it must be pointed out that this flexibility in curating the learning environment was also enabled by the way these places were constructed and the choice of objects made available to museum educators. In museums, the availability of storage areas allowed participants to put away what they deemed was unnecessary for their session. When participants travelled to venues outside the museum, many of them brought objects and technology that they needed, then used whatever furniture and equipment were available in the venue they were allocated to use for the program.

The mobility of furniture (Dane, 2016) provided participants with the opportunity to reconfigure the environment, change seating arrangements, and even completely do away with them. This finding supports Massey's (2005) view that space is constantly changing and continuously undergoes construction and reconstruction. However, the flexible quality of the learning environment was only activated through an interaction with its user, in this case, the participants. Furthermore, time was a necessary element required to enact the latent flexibility of the learning environment (Wood, 2017). In other words, if participants did not have time to curate their learning environment, then the flexible quality of the constructed teaching space would not have been of value.

Another factor that seemed to contribute to participants' curating their environment was the agency they had in making changes that they deemed were necessary for the delivery of their program. Agency (Giddens, 1984) is the capacity to act on their own accord and effect change or make a difference (Pickering, 1995; Rose, Jones, & Truex, 2005; Barad, 2007; Leonardi & Barley, 2008; Orlikowski & Scott, 2008). Furthermore, humans use the technology available to them to work towards achieving the goals they set for themselves (Leonardi, 2011). This agency enabled museum educators to curate their learning environment—not only in the use of furniture but also technology—to ensure the effective use of space to deliver their programs.

Not only were participants allowed to curate museum classrooms for their use, but it appeared that this practice was even encouraged by the institution. Museums may not have assigned dedicated classrooms to individual participants. However, they had a variety of places, materials, furniture, and equipment made available for museum educators' use. Even participants who conducted programs outside the museum demonstrated this agency. Most of them curated elements within their learning environment despite the fact that they were not "part" of the institution. The 'freedom' offered by the museums and schools offered increased agency for museum educators to use the space to its full potential. This relates to the culture of the organisation which is key in facilitating innovative pedagogies in new spaces (Blackmore et al., 2011).

Additionally, all participants of incursion into schools have never been to the learning environment where they conducted their program. Despite being in unfamiliar places, it did not appear to have hindered their ability to curate the learning environment to suit their needs. The ability to curate unfamiliar learning environments stemmed from museum educators' mindsets (and agency) to "try unfamiliar and different ways of teaching, to change practices, take risks and reflect on what works" (Mahat, et al., 2017, p. 36).

Furthermore, they demonstrated the proclivity to use or make do with whatever the venue offered. In one instance, when tables were not available, a participant took it upon herself to source these elsewhere from within the school. She even recruited people who are not technically part of her "team" to help in the process of procuring and returning these tables. This supports what Rose and Jones (2005) calls "intentionality" (p. 276), which is a unique human quality allowing us to act with the aim of achieving specific outcomes. This suggests that participants retained their agency to curate their learning environment, regardless of its temporality.

Sommer (1977) contended that a classroom is composed of a multitude of connected micro-environments. He added that it is possible that in one classroom, "the lighting is much better in one part of the room than elsewhere, it is cold over by the windows, and perhaps too warm by the heating vent" (Sommer, R., 1977, p. 175). He continued to say that students' views from across the room may vary depending on certain factors such as resulting glare from ceiling lights. Some participants have demonstrated awareness of these micro-environments despite not having articulated them explicitly during interviews. One participant stated during the interview that since lighting inside the museum's classroom is not ideal, she arranged activity stations and groups' seats in areas that were illuminated better, demonstrating cognisance of varying conditions within her learning environment and deliberate intention to mitigate issues. The ability to understand and effectively use physical space for pedagogical advantage or what Lackney (2008) termed as 'environmental competency' is evident amongst the participants.

6.3.2 Public learning places

Aside from teaching in shared venues, many of the participants also conducted sessions in public areas – spaces accessible to individuals who were not part of the group of students for whom the participants were conducting the programs. These included high traffic zones such as lobbies, exhibition galleries, hallways, elevator, and streetspaces (Dovey & Fisher, 2004). In art museums, the artworks on display, the architecture of the gallery, and the presence of other people influence visitors' behaviour (Terrassa et al., 2017). Along the same arguments, I contend that these elements also impact how participants use the learning environment for teaching, as revealed by data from this study.

Similar to streetspaces (Dovey & Fisher, 2004) in schools, many of these areas were not primarily designed as teaching venues and presented additional challenges for participants. Environmental factors such as light levels, placement of entrances and exits, noise, visitor traffic affect visitor learning (Hein, 1998). In particular, children's cognitive function and ability to perform tasks are profoundly affected by high levels of noise (Woolner, 2010). Hence, participants also considered these when curating their learning environment. Since using public areas hindered, if not completely prevented, participants from manipulating its physical components, therefore, curating these places entailed studying, understanding, identifying, and selecting suitable areas and elements to create a micro-learning environment that suited participants' pedagogical needs.

An understanding of the various spaces within the museum and their corresponding environmental conditions allowed participants to purposely select micro-learning environments in the museums where they temporarily stopped for group discussions. They tended to avoid high traffic areas and locations with poor acoustics. Sometimes they also employed creative solutions to issues of the learning environment, such as in the case of participants from the Museum 3 who took lessons from a theatre performer to mitigate the acoustical problems with the museum's galleries. It was also apparent that participants, while mindful of other users of their shared space, did not subscribe to the myth that museums should be quiet spaces where talking was discouraged (Mayer, 2012). On the contrary, they encouraged students to interact and converse with each other. Participants' choices in selecting the micro-learning environments were sometimes influenced by students. For example, a few of the participants stopped in front of exhibition objects that caught students' attention, even though these were not part of the program. Pedagogical needs of students also, to a certain degree, dictated participants' decision where to teach and how to arrange these micro-learning environments. For example, some participants selected or made changes to venues and furniture to make it more suitable for the group of students they were teaching based on their age, grade level, and level of skills. This concurs with Freline and Grannäs' (2019) assertion that teachers alter their classroom's design to align with their perceptions of what works. Additionally, they added materials, tools, and equipment into the venue they were using that they felt would be useful for student learning. When educators act as activators of student learning (Hattie & Clinton, 2011) and make teaching and learning visible (Hattie, 2012), they encourage student-centred learning, the use of different types of experiential learning (for example the agility to move seamlessly between independent and collaborative learning) as well as support the use of different learning strategies (Mahat et al., 2017).

Regardless of the type of learning environment (purpose-built teaching areas or public learning places), it appeared that museum educators considered the following in curating the physical aspects of their learning environment:

- kind of pedagogy necessary for the program they are teaching;
- age or grade level of students.
- physical attributes of the learning environment including its indoor environmental qualities (IEQ);
- comfort of students. Students need to feel safe and comfortable are conditions necessary for them to learn in museums (Mayer, 2007);
- expected or known behaviours of other users of the shared learning environment; and finally
- resources available to them.

This chapter sought to elucidate where museum educators teach student groups. Based on data presented in this chapter, regardless of whether the program is an Excursion into museum or an Incursion into schools, museum educators predominantly taught either in purposely-built teaching areas or in public learning places. Examples of the former are theatres and classrooms while the later include areas inside museum galleries and streetspaces (Dovey & Fisher, 2004) in schools. They also taught while they were in incidental teaching places such as museum lobbies, elevators, hallways, and outdoor spaces. I described how these learning environments looked like, and in some cases, provided photos to help illustrate the different learning environments used by museum educators while teaching student groups in schools and museums.

The three factors that were highlighted in the physical context of the Contextual Model of Learning (Falk & Dierking, 2000, 2013) are highly relevant in the context of this study. These factors include orientation to the physical space, architecture and large-scale environment, and design and exposure to exhibits and programs. The decisions that a museum educator make are informed by how well oriented they are on the physical features of the space they are using. The elements that they have access to and used were limited or aided by the structure of the architecture and large-scale environment as well as the design of the exhibits and programs.

Four key themes arose from the museum educators' use of the learning environments: their agency to curate the learning environment, their spatial competency to understand and effectively use the learning environment, the organisational culture as an enabler to build agency and competency, and finally at the heart of it, the impact on students as museum educators transitioned from different types of student-centred learning. These provide points of departure for the discussion in Chapter 9.

6.4 Summary

In this chapter, I presented an analysis of data from observations, interviews, audio recordings, photographs, and research journal to answer the first secondary research question on where museums educators teach and how these learning environments looked like. After a more thorough examination of the various sites where data was gathered, an analysis of ten different types of learning environments used by museum educators was also discussed. I ended this chapter by comparing empirical findings with relevant literature. In the next chapter, I present data relevant to my secondary research question on how museum educators use the learning environment for supporting student learning.

CHAPTER 7: PERSONAL CONTEXT: PEDAGOGIES OF THE LEARNING ENVIRONMENT

This chapter is the second of three chapters focused on reporting findings from my data collection. Findings presented in this chapter come from primary data sources such as program observations, excerpts from my research journal, and semi-structured interviews with participants. Additionally, I also utilised data from audio recordings of programs observed, teaching artefacts such as worksheets and handouts during or after the programs, and photographs of the learning environment and objects within that I took. The audio recordings, notes from my research journal, and photographs were vital resources that I used in writing the vignettes, or short descriptive accounts, included in this chapter. As described in Chapter 5, vignettes are retelling of the observation sessions and include actions and words spoken by participants as well as responses and reactions from both the participants and the students.

Findings in this chapter addressed this secondary research question:

> *What and how do museum educators use elements contained within these learning environments in teaching student groups?*

I organised this chapter into three sections. In the first section, I elaborate on elements in the learning environment that participants used for teaching. In the second section, I proceed with identifying various ways participant used different elements of the learning environment in teaching. As elements in the learning environments overlapped for both case study sites, I have conflated the findings in the two sections. Finally, I concluded this chapter by weaving together salient findings from the data presented.

7.1 Elements of the Learning Environment

This section is structured based on the observation checklist discussed in Chapter 5. Two things are of interest: Firstly, it is interesting to note that interactive components as an element was not used by participants during my observations.

Secondly, 'natural environment' was identified as an additional element in my observations. This will be discussed further in the discussion section.

Participants used a variety of different elements for teaching. **Figure 7.1** demonstrates how often participants utilised each element during the teaching sessions that I observed. It also shows which elements appear to be more popularly used for Excursions into museums and Incursions into schools. These frequency counts are based only on my observations of the programs.

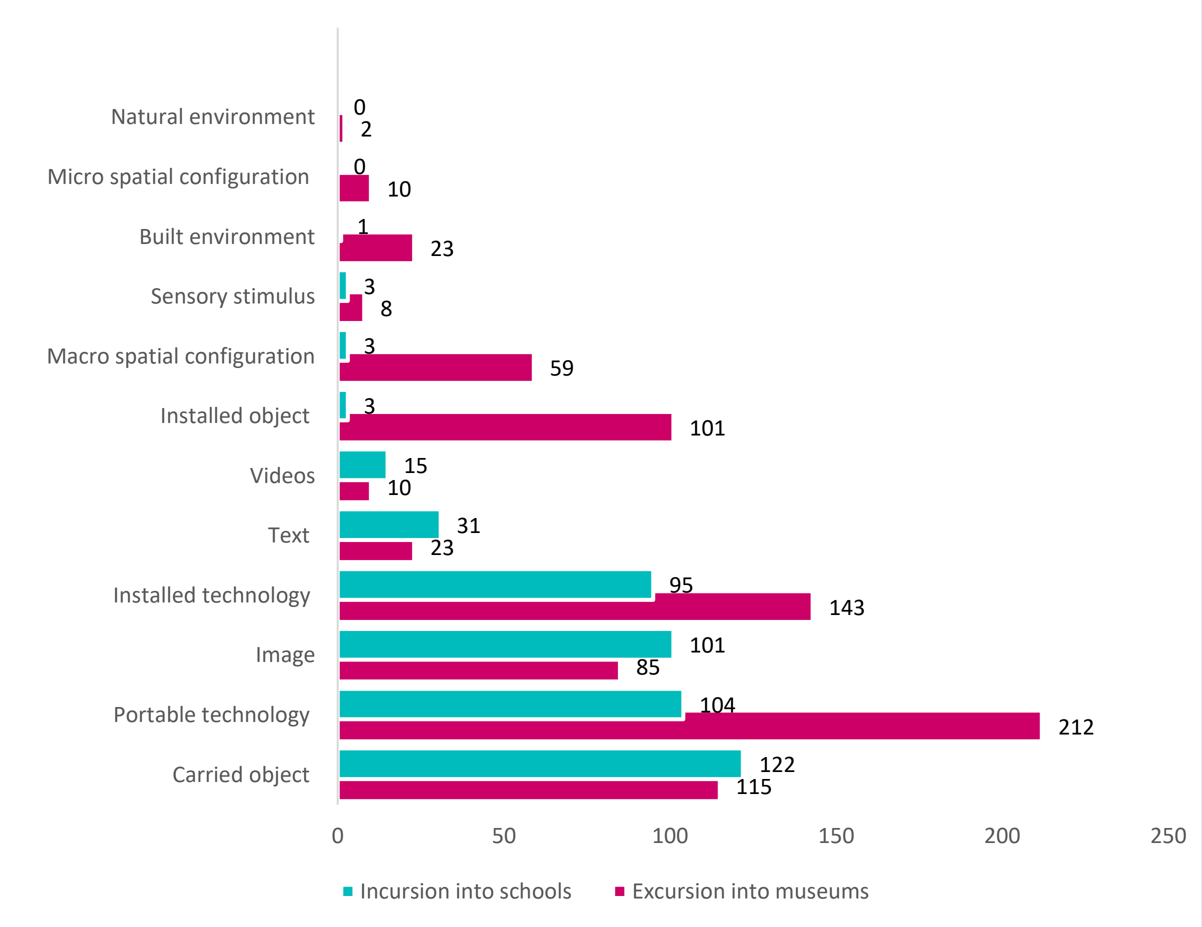


Figure 7.1. Elements used by participants

It appears that for Excursions, many of the participants used technology for teaching. Most of the technological devices used by participants work in tandem with other devices. For example, when participants used an LCD projector, these were connected to a laptop or a desktop computer. Sometimes, an audio system composed of a microphone and speakers were also connected to the computer. Each of these devices were counted individually.

Furthermore, some elements, such as sensory stimulus, videos, and images, required technological devices to be utilised for teaching. All these factors contributed to the increase in frequency count for technology. It seemed that participants used more portable technology than those that were already installed in the learning environment. This may indicate that participants purposely included and used additional technology in their learning environment to suit their needs. Similarly, there were slightly more carried objects used compared with installed objects, indicating that museum educators did not rely solely on objects that were already in the learning environments they were using. Instead, they enhanced the learning environment with additional objects for their session.

For Incursions, carried objects and portable technology were the two most used elements for teaching. Participants tended to bring everything they needed for their session instead of relying on what their assigned venue might offer. Some of them also prepared for when things did not go according to their plan or when what they needed was not available in the learning environment assigned to them. For example, Educator 21 shared one of the most challenging experience she had during an Incursion:

> *Once when the electricity went off with the school hahaha. So, we had no light we couldn't do the PowerPoint. Angie and I were together doing a joint presentation that time so we made do as best as we could, but you can't always have the resources that you want. (Educator 21, Museum 8)*

She added that when they leave the museum and go to other venues, they always keep an open mind:

> *You have to be extremely flexible. You have to plan for everything to be different than you think it's going to be so you do have to be very flexible and you can't have a rigid idea of how your delivery is going to go. You have to be very open-minded. (Educator 21, Museum 8)*

I will now elaborate on the various elements in the learning environment that participants used for teaching. For this section, I will only describe the elements and will not provide too much details on how participants used them as that will be the focus of the next section. Unlike the previous findings chapter, I am not dividing this section into the two case studies. Instead, I will present results, per element, together. This is to avoid repeating the same information because the overall descriptions of elements remain the same regardless of whether it was used for Excursion into museums or Incursions into schools. However, I will indicate if the example is from an Excursion or an Incursion. Data for this section were drawn both from observations as well as interviews of participants.

7.1.1 Object

There were two types of objects used for teaching in this study, **installed** and **carried.** These two were distinguished based on whether they were permanently included in the learning environment, or if the participants added these specifically for their use in the program.

Common examples of **installed objects** that I noticed participants of Excursions into museum case study used were:

- memorabilia, historical, archaeological, and cultural materials or artefacts;
- visual artworks such as paintings, drawings, sculptures, photos, video art;
- scientific specimens and instruments such as telescopes; and
- animal taxidermy.

All the items listed above were part of an exhibition. Below is a vignette describing a scenario from an Excursion into museums where students focused on a painting:

Vignette 3: You crossed this bridge this morning!

The group entered the 19th Century Australian Art gallery, which was one of three galleries that visitors can enter upon getting off the lift to level 2. This gallery mostly had paintings hanging from the walls and on panels that divided the big gallery into "smaller galleries" showcasing less than a dozen artworks threaded by a common theme. It had big empty spaces in the middle that were occasionally punctuated by sculptures standing on white pedestals. Some areas had about half a dozen grey wooden chairs clustered in the middle of the open space, arranged with their backrests against each other. Educator 16 asked students to open up their portable stools, which they had collected from the reception area, and then sit in front of three landscape paintings hanging next to each other. There was ample space in front of the paintings for students to position their stools without impeding gallery traffic.

They started by briefly discussing the history of Western people's arrival in Australia – who they were, when they arrived, and where they settled. Then he directed students' attention to one of the paintings, an urban landscape entitled "Swanston Street from the Bridge" completed by Henry Burn in 1861. Then he said, "here is our first urban landscape—but this was a fairly long time ago. Does anyone know where in the world this picture could be from?" Students spent a few moments examining the painting and started shouting out their guesses. When one student said it's in the English country, Educator 16 enquired why she thought so. In response, the student pointed to a tall building in the painting. He looked at the painting and with a nod, added, "Yeah, it does have an English vibe to it. So possibly somewhere from England?".

Figure 7.2. "Swanston Street from the Bridge"

Eventually, someone said Swanston Street, to which Educator 16 remarked, "why Swanston Street? That's very specific." Apparently, this student read the caption before they sat down and remembered what was written on it. Educator 16 commented that he was purposely standing in front of the wall label to obscure it from students' view because he wanted them to look at the painting and use what is depicted in it for them to figure out the location of this scene. "Well, you're right, it's written on the wall there." He commended the student for paying attention to his surroundings and reading the signs. "Yes, so this is Swanston Street from across the bridge". While pointing to the bridge in the painting, he added, "you literally crossed this street to get here this morning, you crossed this bridge!" He shared that he personally likes this painting because "this is not a made-up picture". Instead, the painting is an image of how Swanston Street looked like at that time. He continued to say that Burns, the artist, "while standing on that bridge, this is the scene that he saw, and this was how Melbourne looked like in 1861." They went on to discuss how different Melbourne was in 1861 compared to the present.

Most of the Incursion into school case study sessions were held within school premises. The only installed exhibition objects used by participants for this case study were photographs included in the "Australia will be there" exhibition and a sculpture that was not part of the exhibition, but was coincidentally relevant to the topic of the program.

When the same objects listed above were brought in by a participant specifically for use in the program, then I considered them as carried objects. It did not matter if the artworks, artefacts, and specimens were replicas or reproductions; I still noted these as ‘objects’. An example of this was the animal taxidermy used by participants from Museum 4 (**Figure 7.3**). Many of the big animals were on platforms that had wheels so that museum educators could push them in and out of storage. Another example was a cart containing various types of cameras that Educator 4 from Museum 3 used for her program (**Figure 7.4**). This cart was not part of the exhibition, and she just wheeled this in the gallery specifically for her particular session.

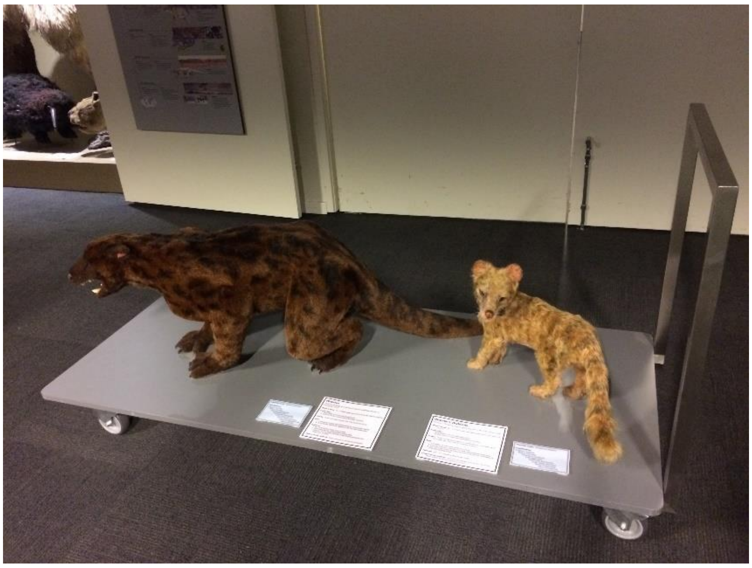


Figure 7.3. Animal taxidermy in Museum 4

Figure 7.4. A cart with different types of cameras in Museum 3

There are three categories under carried objects: (a) museum objects, (b) furniture, and (c) teaching materials. I have already explained the museum objects above. In both case studies, I also regarded furniture that has wheels such as tables, chairs, and whiteboards, as carried objects. However, this furniture was only noted down if the participant actively used it in teaching, such as the tables that had writeable surfaces at the Learning laboratory (name of facility changed to retain anonymity) of Museum 9 (**Figure 7.5**).

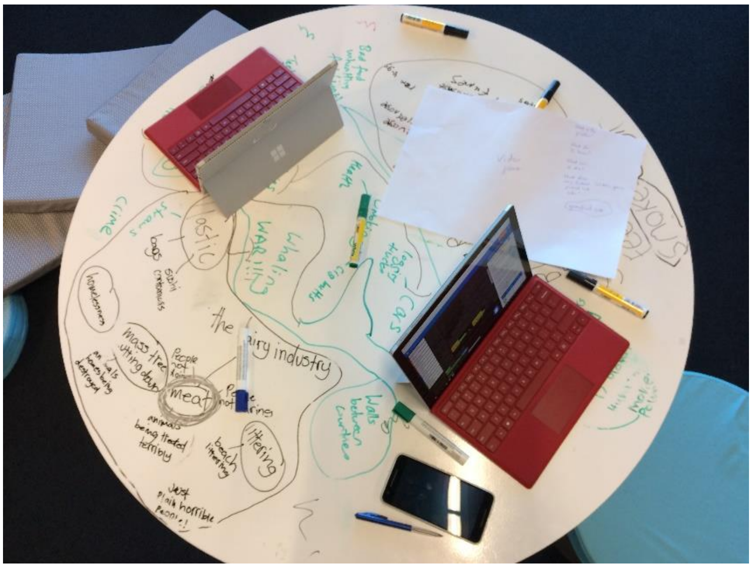


Figure 7.5. Table with a writeable surface used in Museum 9

Additionally, I saw participants use art supplies, flip boards, clipboards, drawing materials, measuring tools, building blocks, toys, palaeontologist tools, floor puzzles, books, maps, printed diagrams and tables, and activity sheets. I called these teaching materials.

During one of the Excursion programs taught by Educator 8, which was focused on space exploration, he wore an astronaut jumpsuit costume and introduced himself as Commander Chip. Educator 20, whose Incursion program was centred on astronomy, also wore an astronaut jumpsuit costume. Sometimes the costumes were for participating students such as those used in the Australian Gold Rush program at Museum 5 and at the Dinosaur Hands-on program at Museum 4. At Museum 6, they used to have costumes for students, but Educator 18 explained that they no longer used these:

> *We also have costumes as well, dressing up students in some periods of works. There was a sort of issue with health and hygiene concern with those I think, that they got of sort of got packed away. (Educator 18, Museum 6)*

I also considered these costumes as teaching materials.

7.1.2 Technology

Installed technology are electronic devices and accessories that I saw participants use that were permanently installed in their learning environments. Examples of these in Excursions were desktop computers, speakers, TV, LCD projectors, virtual reality (VR) headsets and handheld controller, microphones, and touch tables. In Incursions, participants only used LCD projectors.

I considered **portable technology** as anything small enough to be carried with one hand that participants brought into the learning environment to augment their teaching**.** Examples of what I saw in Excursions were laptops, iPads, Microsoft Surface tablets, computer mouses, mobile phones, handheld scanners, microphones, headsets, virtual reality (VR) cardboard glasses, digital single-lens reflex (DSLR) cameras, webcams, video stabiliser for mobile phones, and several types of computer software.

Some participants in Museum 5 used robots, such as a robot rover used in a simulated Martian surface and a commercially available educational programmable electronic robot kit called a mBot (**Figure 7.6**). These mBots, Educator 11 said, are not very expensive, costing between $120 to $150 per kit. She thought that schools could afford to have a few of these in their classrooms for students to use in a variety of subjects, such as Mathematics, and not just for computer programming.

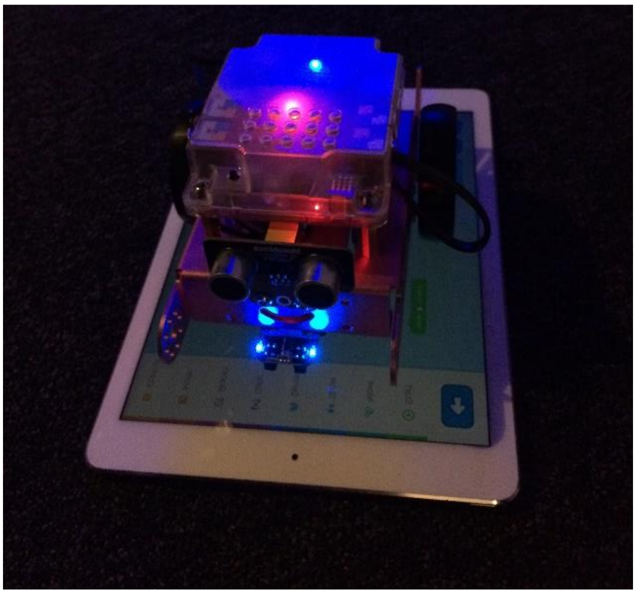


Figure 7.6. A mBot on top of an iPad in Museum 5

Although the Learning laboratory of Museum 9 is heavily infused with technology, there was a conscious effort by the museum to select equipment and tools that may also be available to classrooms. Educator 27 elaborated:

> *I think, it's a bit of an illusion that this is a fancy expensive Learning laboratory. Like, we are, obviously, really lucky and privileged to have a bit of a space, uhm, and we do have some expensive pieces of technology in here like the big-touch tables, and obviously, the vibe [inaudible] virtual reality cost money. Uhm, but as much as possible, we are using, technology and processes that are free and accessible. Like, you know, the google cardboards with, you know, they work with their phones and web-based tools. And yeah, it's nice to sort of combine those. You know, we can combine some things that cost more money and some things that are available and free. (Educator 27, Museum 9)*

Portable technology used by Incursion participants were laptops, mini-speakers, portable LCD projectors, flashlights, laser pointers, and various computer software.

7.1.3 Image and video

Images are static visual representations such as photos or illustrations that are usually two-dimensional in form. Images used by participants were either printed or in digital format and displayed using an electronic device. In contrast, **videos** are the digital recording of a series of images, events, performances, interviews, or animations that are viewed using an electronic device with a screen or projected onto a screen.

In Excursions, typically inside exhibition galleries, I saw images and videos incorporated in information panels, exhibition captions, supplementary exhibition notes, or carried by participating museum educators as a teaching aid. I have excluded from this category those images and videos I have seen inside museum galleries but are among the objects on exhibit, i.e. photographs or illustrations by artists or video art. I also saw participants of both Excursion and Incursion use some photos and videos of people, animals, places, events, buildings, and objects. They also used moving images displayed as part of the learning environment's set-up for the program. Sometimes they showed videos to students during a specific section of the program. For example, Educator 6 had some photos of animals next to a time period on the timeline of earth's history. These photos (**Figure 7.7**) were attached via Velcro on one of the museum classroom walls. In some cases, images were printed out and laminated, such as those used by Educator 21, which showed how Australian soldiers wore their uniforms during World War 1 (**Figure 7.8**).

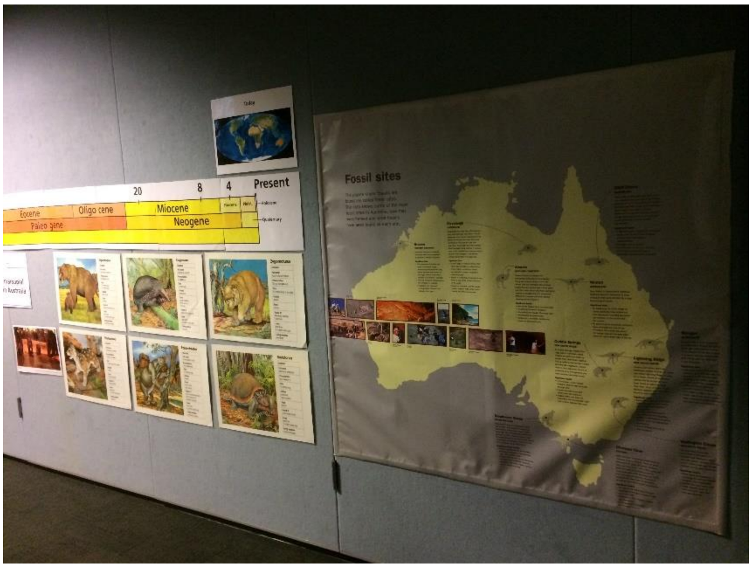


Figure 7.7. Images used by Educator 6

Figure 7.8. Photo of an Australian World War I soldier

7.1.4 Text

Text is the collective term I used to refer to words and other textual materials displayed in the learning environments or carried by participants. In Excursions, I saw text included in the exhibition title, introduction panel, object labels and captions, and narratives on gallery walls used by participants. In other learning environments for Excursions, participants used instructions for the activities, captions for specimens, contextual information about objects, labels for objects, and keywords relevant to the topic being discussed. In the previous Findings chapter (Chapter 4), I described how Educator 1 used laminated papers containing the words “stone wall” and “timber shingle” to assist students in labelling their diagrams.

In Incursions, specifically the programs taught by Educator 19, Tongan words, poems, and song lyrics were projected on a screen. She also had written up and posted the simplified instructions to students for creating their print design (**Figure 7.9**).

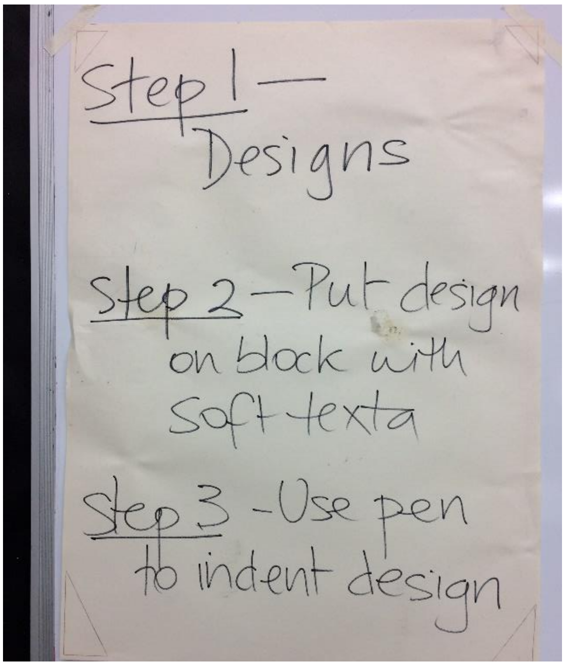


Figure 7.9. Instructions for creating a print design

7.2.5 Built environment

I refer to the physical structures that are part of the learning environments as the **built environment**. An example of physical structures that I saw in Excursions are historic buildings, such as the one used by Educator 1 in *Vignette 1: A different time, a different life*. Other examples include seats that were bolted onto the floor, an observatory dome in a planetarium, and architectural details of buildings such as staircases, windows, doors, chimney, bell towers, walls of rooms, wall finishing of buildings, floor tiles, floor carpet, and ceilings. Sometimes, participants used the built environment indirectly. One example was during a session facilitated by Educator 4. Below is an excerpt drawn from my research journal.

She started her session in the museum's lobby then brought the students into the museum's theatre and used real museum objects to supplement the PowerPoint presentation she delivered inside the theatre. Shortly after all students were settled in their seats, she briefly introduced the museum and its collections. And then she asked students to look under their seats. This instruction was met with a few shrieks of excitement with students practically diving under their seats to find out what was in store for them. A handful of students seated in the front row were thrilled to have found old fashioned cameras under their seats. Educator 4 had hidden them there before the session.

For this research, I considered immersive exhibitions and immersive components of an exhibition as part of the built environment. Immersive exhibitions are those that physically enveloped a student or the whole student group. These were intended to make them feel as if they have been transported to a different time or place. At Museum 5, they have a Zero Gravity Space Lab where students had the opportunity to experience how it feels to be weightless. They also have a habitation module that showed where astronauts sleep, eat, exercise, shower, etc. The module's design was based on a prototype for the International Space Station.

In Incursions, the only built environment used was a display lattice in one of the classrooms (**Figure 7.10**) used by Educator 19.

Figure 7.10. The display lattice used by Educator 19

7.1.6 Natural environment

As explained in Chapter 6, 7% of Excursions case study participants taught students in other areas of the museum, including its outdoor spaces. As described earlier in this chapter, Educator 1, conducted about half of her sessions outdoors and referred to elements of the natural environment while teaching. She used the trees on a hill as a reference point in showing where convicts who were working at the Homestead used to herd sheep. Another participant, Educator 14, who was teaching a program centred on astronomy called students' attention to the sky and the sun during the session. None of the participating museum educators from incursions used the natural environment as part of their teaching.

7.1.7 Sensory stimulus

Sensory stimuli are any sound, texture, smell, and taste in the exhibition or during the program that I witnessed participants use to generate auditory, olfactory, tactile, or gustatory responses. Educator 3 from Museum 3, for example, sometimes modified her voice when she was telling stories. She also said to me during the interview that she has, in other programs, used smell in teaching:

Oh yes I have. I've used eucalyptus oil in cotton in stories of early contact. Because I'm thinking in aboriginal people, living off the land, doctors, they knew what? (Educator 3, Museum3)

Educator 5, another participant from Museum 3, said that she has used smell as a sensory stimuli as well:

Yes. Yes, in other activities but not particularly with the suitcase. It's not a very smelly object haha… When we talk about a Chinese migrant who came for the gold rush. He practiced medicine on the gold fields. And there's a wooden gourd that we have and we covered that with rosewood scents coz the gourds were often made with rosewood. That's one time when I've utilised a smell. (Educator 5, Museum 3)

When I asked her about using sounds, she said that she used sound for visually impaired students to help them figure out that the object was made of wood.

I use the sound sometimes and like particularly if we have vision impaired students, you know, I knock on the suitcase and students can work out it's made of wood. So, it has a particular sound. So the sound of the objects are the only sound that I would use. (Educator 5, Museum 3)

Other sounds used in Excursions were audio narrations. In the programs facilitated by Educator 1 from Museum 1, she included audio of a slave talking about the fifty lashings that he received as punishment. Both of Educator 9's programs at Museum 5 utilised sounds too. In the program focusing on space exploration, he played the sound that the Sputnik 1 satellite made when the USSR launched it in the 1950s. He also played the audio of the United States (US) President John F. Kennedy's famous 1961 speech declaring that the US will send a man to the moon before the decade ends. In the Gold Rush program that he facilitated, to introduce changes or new rules for the role-playing game with which the students were engaged, he used pre-recorded audio instructions, which had an accompanying static image projected on a screen, In her program, Educator 24 reminded students before going inside a simulated trench in the Gallipoli exhibition to pay attention to and feel the vibrations caused by bombs exploding nearby during the Great War.

Another participant, Educator 4, also from Museum 3, said that she manipulated the lights in other programs that she has taught:

> *I would dim the lights. Sometimes I dim the lights. It wasn't necessarily appropriate with this one, but for that one, I had some ice cream sundae that would pop up on the screen. And when it showed that one, it's the first one, I dim the lights, and it would stand out. And we could choose our favourite ice cream sundae. It's very exciting! (Educator 4, Museum 3)*

For Incursions, only Educator 19 from Museum 6 used sounds while teaching. To wrap up her sessions, she projected the lyrics of the song "Happy happy Tonga" on the screen in the front of the classroom, played the music using a small portable speaker then asked students to sing along with her.

7.1.8 Spatial attributes

Spatial attributes refer to the existing set-up of the physical elements within the learning environment. I divided spatial attributes into types, the macro and the micro. **Macro spatial attributes** focus on the location of elements in relation to others within the space. This also accounts for blank or open areas such as voids left by the absence of elements. On the other hand, **micro spatial attributes** refer to participants' use of the physical arrangement of elements on a smaller scale, such as on a wall or within a display case.

In museum galleries used for Excursions, participants utilised macro spatial attributes when they took into consideration certain factors such as the way an exhibition gallery was laid-out, how walls were arranged, where display cases were, or if there was a wide space in front of a painting in deciding where to position themselves and their students while conducting the programs. An example of macro spatial attribute is illustrated in **Figure 7.11**.

Figure 7.11. Example of macro spatial attribute used by museum educators

Inside classrooms for Excursions, and throughout most learning environments used in Incursions, I saw this applied in the way student desks, screen projectors, bookshelves, and other furniture were arranged. Often, museum educators utilised macro spatial organisation to create multiple focal points in the learning environments. Additionally, macro spatial attributes, specifically, blank spaces, allowed museum educators to move around, between, and behind students, which in turn removed the permanent “front” of the room[7].

In Excursions, participants took advantage of the physical arrangement of various displays within the exhibition, within a set of objects in a display case, or items on a wall while teaching. Micro spatial attributes were not used during incursions.

7.2 Affordances for teaching

As discussed in Chapter 2, this research adapts affordances as action possibilities (Hammond 2010; Heft, 1989; McGrenere & Ho, 2000; Turvey, 2012). For this

---

[7] In traditional classroom layouts, the teacher’s desk and the blackboard/whiteboard are usually on one side of the room, the front, and students’ desks are arranged facing this side (Ford, 2016).

study, I documented the enacted affordances—how elements were used by museum educators for teaching.

During my data collection, both for Excursions into museums and Incursions into schools, I identified 19 affordances. From these, 16 were already included in the observation checklist that I developed in preparation for data collection (see Chapter 3). The additional three affordances (encourage problem-solving, prompt communication, and produce immersive experience) emerged during data analysis. The 19 affordances listed below summarises the various ways that participants in this study used different elements of the learning environment.

- Create authenticity
- Offer choice
- Foster collaboration
- Stimulate creativity
- Incite critical thinking
- Spark curiosity or imagination
- Illicit emotional response
- Provide experiential learning
- Illustrate a concept, process, or information
- Transmit information
- Actuate/allow movement
- Enable spatial flexibility
- Provide relevance
- Trigger sensory experience
- Shift authority
- Promote visual engagement
- Encourage problem-solving
- Prompt communication
- Produce immersive experience

All the elements identified in this study appear to have multiple affordances, as illustrated in **Table 7.1**. The shaded cell means that each object (in the top row) offers the affordances (in the first column). For example, carried objects have the most affordances and the only element that had all 19 affordances used by participants. This is closely followed by portable technology and built environment, which had 17 different affordances each. As illustrated by **Figure 7.12**, these two elements, portable technology and built environment, share 15 of the same affordances. However, portable technology was not used to enable spatial flexibility and create authenticity, while the built environment was not used to provide experiential learning and encourage problem-solving.

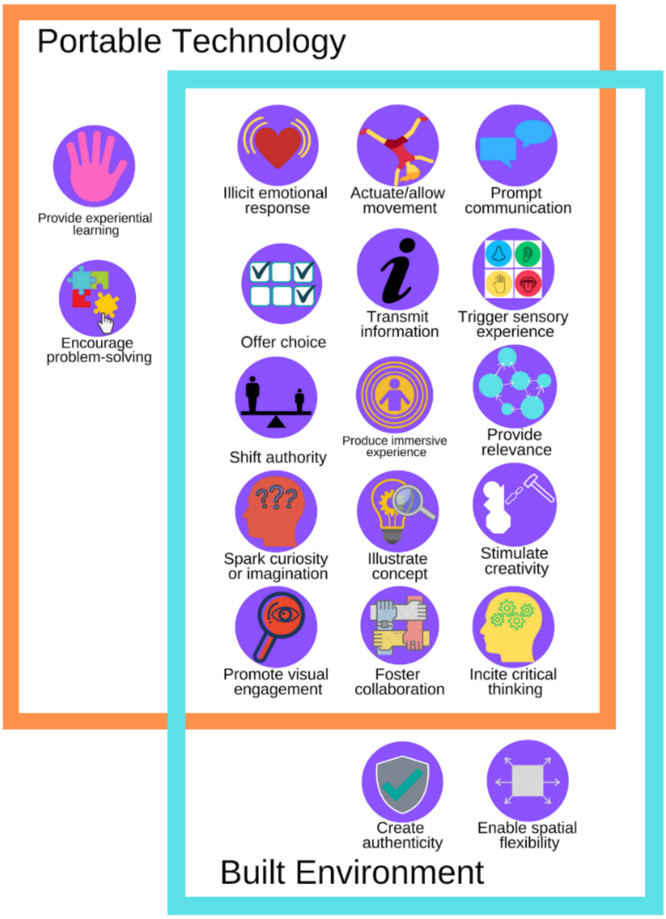


Figure 7.12. Portable technology and built environment affordances comparison

Another example of elements having the same affordances is carried object and installed object. They both share 16 affordances, as illustrated in **Figure 7.13**. Together, these two elements cover all 19 affordances identified in this study. One of the most common affordances of objects utilised by participants, regardless of whether it is carried or installed, was promoting visual engagement. An object that was physically available in front of students allowed them the opportunity for active looking and visual engagement. When the participants presented their students with an actual object, the first thing that they invited students to do was look at the object. This was especially true for art objects, scientific specimens, and historical artefacts and applied to both carried and installed objects regardless of whether it was during an Excursion into a museum or an Incursion into schools case study. Many of the Excursion participants who brought students to the museum's exhibition gallery asked students to look closely at the object displayed in front of them before starting any discussion. It was typical for participants to continue inviting students to visually engage with an object throughout their discussion.

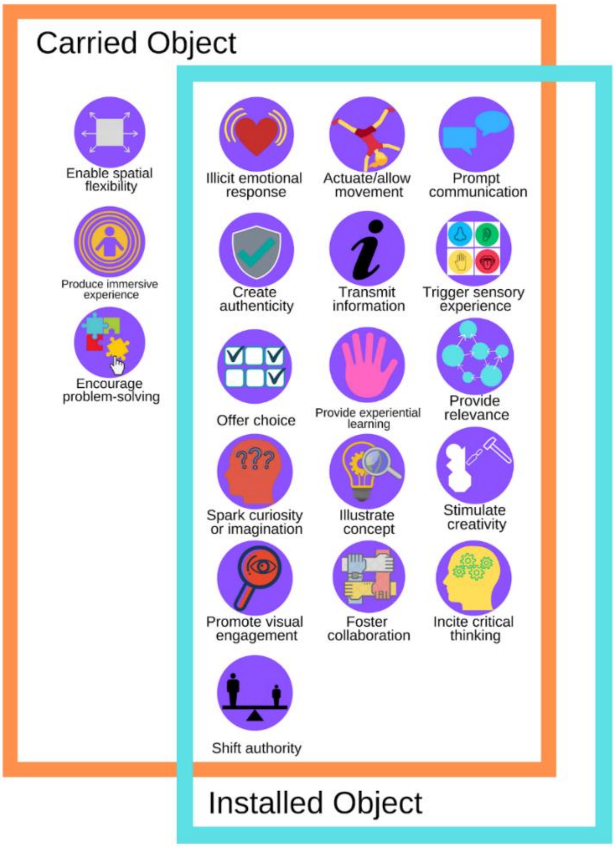


Figure 7.13. Comparison of pedagogical affordances of objects

Table 7.1

Summary of elements and their affordances

ELEMENTS	Carried Object	Portable Technology	Built Environment	Installed Object	Installed Technology	Image	Natural Environment	Video	Text	Sensory Stimulus	Macro Spatial Organisation	Micro Spatial Organisation
AFFORDANCE												
Spark curiosity or imagination	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Incite critical thinking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Illicit emotional response	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Illustrate concept, process, or information	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Transmit information	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Offer choice	✓	✓	✓	✓	✓	✓			✓		✓	✓
Actuate/allow movement	✓	✓	✓	✓	✓	✓	✓	✓			✓	
Provide Relevance	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Promote visual engagement	✓	✓	✓	✓	✓	✓	✓	✓				✓
Foster collaboration	✓	✓	✓	✓	✓	✓					✓	
Prompt communication	✓	✓	✓	✓	✓	✓						
Trigger sensory experience	✓	✓	✓	✓	✓					✓		
Shift authority	✓	✓	✓	✓	✓	✓						
Create authenticity	✓		✓	✓		✓	✓					
Stimulate creativity	✓	✓	✓	✓	✓							
Provide experiential Learning	✓	✓		✓	✓						✓	
Produce immersive experience	✓	✓	✓							✓		
Enable spatial flexibility	✓		✓								✓	
Encourage problem-solving	✓	✓			✓							

I use *Vignette 3: You crossed this bridge this morning!* to illustrate my point further. Visually examining the painting was critical for this activity; however, visual engagement was not the only affordance of this painting Educator 16 used. By withholding the full information about the painting and asking students to guess, I imagined that he was counting on the student's curiosity to prompt them to investigate the painting further. This was another affordance, spark curiosity or imagination. "Where in the world is this scene from?" "Is there something here that I recognise?" "What is that tall building in the centre?" These were perhaps some of the questions that students asked themselves in response to his questions. When he asked them to look closely at the painting and focus on specific details before guessing, he was encouraging them to make an inference based on what they can see and what they know. In doing so, he invited students to think critically about the painting too—another affordance, incite critical thinking. They needed to analyse images in the painting then combined what they saw with what they knew about the world before making an informed guess.

During the discussion, when a student ventured a guess, Educator 16 always asked the student to support their answer with evidence, such as particular images in the panting or information they already know. He asked questions like "What do you see that made you say that?" or "What about those buildings?" to encourage students to share their thought-processes. Hence, responses from students were not just random guesses, but products of short critical thinking exercise prompted by an open-ended question about the painting that was right in front of them. In asking students to share their inferences, he was prompting them to communicate what they are possibly learning and articulate their thought process, yet another affordance, prompt communication.

When he pointed to the bridge and emphasised that students crossed that same bridge just that morning on their way to the museum, this was two more affordances: (a) illustrate a concept, process, or information; and (b) relevance. First, he used the painting to help show the information he was giving students – this bridge in the painting is the same bridge that students crossed earlier. This scene, bridge, and street all existed both in the painting and in real life. After he said, “you crossed this bridge”, I saw a few nods of agreement and a few students audibly say “ohhh”. This group is composed of students from a secondary school in Victoria, Australia. Swanston Street is the main thoroughfare in Melbourne City, the capital of the State of Victoria in Australia. The nods and oohs were perhaps due to these students finally making that connection between this painting and their real life. As students who live in Victoria, they knew where Swanston Street was, and they most likely have walked along this street multiple times in the past. This meant that they were physically in that location depicted in the painting, although in a different time period. When Educator 16 added that the scene in the painting was not a made-up place, he further emphasised that connection with students’ lives. With his help, students identified further differences between Melbourne in 1861 and the Melbourne that students knew by asking them to look back to that morning when they were in that same location, remembering what they saw out on the street, and then comparing it with what they were seeing in the painting in front of them.

Additionally, looking at an actual painting, instead of an image projected on a wall, afforded students with an authentic encounter with a real object. This affordance, creating authenticity, allowed students to get a better sense of the physical characteristics of the object, providing them with opportunity to consider questions such as, “How big is it?” or “How does it compare to other paintings I saw before?”.

In one painting alone, Educator 16 utilised seven affordances, namely:

- promote visual engagement;
- spark curiosity or imagination;
- incite critical thinking;
- prompt communication;
- illustrate concept, process, or information;
- provide relevance; and
- create authenticity.

Another example of a single element with multiple affordances is Educator 4's use of real cameras. By hiding cameras under the theatre seat, she utilised a number of affordances of this object. First, the moment she announced that students should look under their seats, the whole theatre came alive with excited gasps and exclamations as students jumped off their seats eager to discover what was under. She used the cameras to elicit an emotional response - excitement, eagerness, and curiosity.

Second, she used the cameras to underscore how different the lives of students were from the experience of early settlers in Australia. The cameras that students found under their seats were conventional cameras that still required a roll of film to capture images. Many of the young people these days, such as the year seven students who attended the session, are only familiar with digital cameras. "What do these old and unfamiliar cameras have to do with me?"; "Why should I bother to learn about this old camera that I cannot even use?"; "What can this camera tell me about how Australians lived long before I was born?"; "How different are these old cameras from the cameras that I use now?" These were just some of the questions answered during the discussion centred around the cameras that Educator 4 facilitated. In short, she used the cameras to provide relevance between the life of students now and the life of people who lived in Australia before them.

Third, she used the cameras for visual engagement, but by having actual cameras, instead of an image of an old camera projected on a screen, she also created an authentic encounter (authenticity) with a real and physical object for students, a fourth affordance. Fifth, she used the cameras as a provocation for the discussion, meaning some students were asked to articulate their observations of the cameras, what they know about old cameras, their experience using a different camera (such as a digital camera), and their opinions about the contrast between life then and now. Sixth, for students who found cameras hidden under their seats, they were able to handle and examine the cameras physically. Additionally, allowing students to touch the objects they are studying afforded them a multi-sensory experience. Therefore, for this particular part of the session alone, Educator 4 utilised six affordances, namely to:

- illicit emotional response;
- provide relevance;
- promote visual engagement;
- create authenticity;
- prompt communication; and
- trigger sensory experience.

Providing opportunities for students to physically handle objects and not just visually engage with them seems to be something that participants consciously decide to include in their session whenever possible. However, many of these opportunities only occurred when sessions were not held within the museum gallery where most objects on exhibit were hands-off, although an exception to this was Educator 4's session. As mentioned earlier, as part of her program, she wheeled into the gallery a cart containing more objects with cameras. This camera cart provided students with better opportunities to physically handle cameras compared to when they were all in the theatre, where the session started.

Many of the elements were used to incite critical thinking and to spark curiosity as these two affordances were present in eleven of the twelve elements (see **Table 7.1**). Other popularly used affordances include emotional response, illustrating a concept, process, or information and transmitting information as ten different elements were used for these purposes. However, it would appear that no two elements had the same exact set of affordances, even those that belong in the same broad category such as Technology (portable technology and installed technology) or Objects (carried object and installed object). As **Figure 7.14** demonstrates, portable technology and installed technology share 16 affordances. However, it seems that participants did not use installed technology to produce an immersive experience for their sessions. Similarly, carried object and installed object share 16 affordances but only carried objects were used to enable spatial flexibility, produce immersive experience, and encourage problem-solving (**Figure 7.13**).

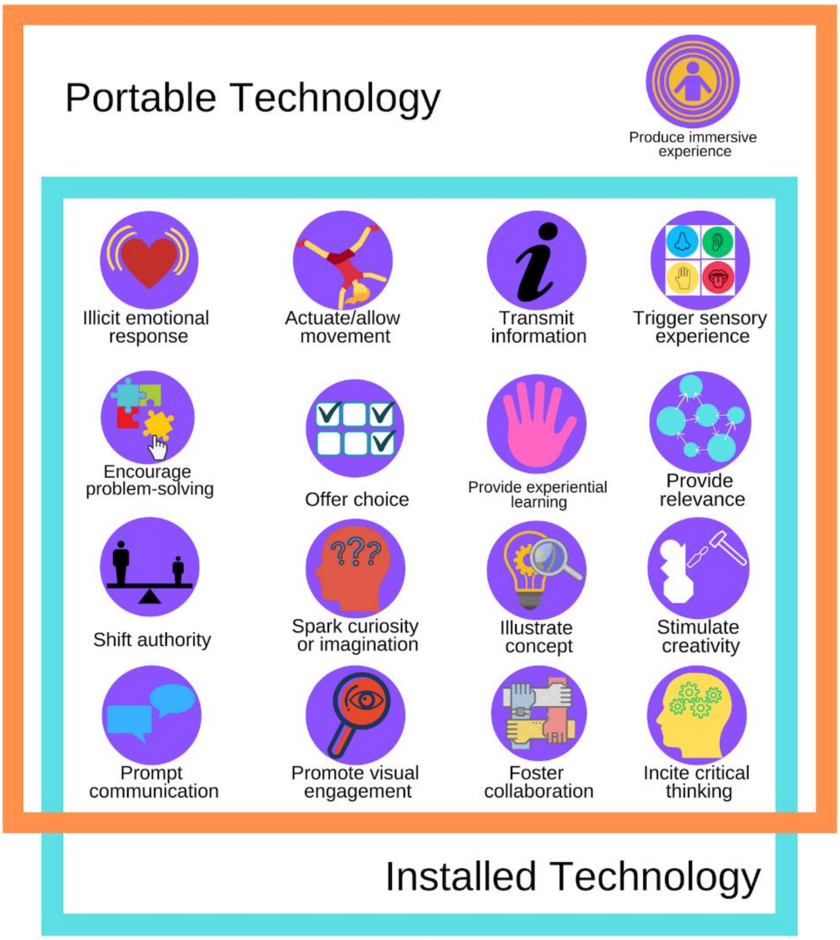


Figure 7.14. Comparison of pedagogical affordances of technology

Table 7.1., presented earlier in this section further demonstrates the similarity and differences of affordances among the different elements.

7.3 Discussion

In this chapter, I presented findings to address the secondary research question below:

> *What and how do they use elements contained within these learning environments in teaching student groups?*

In the first two sections, I focused on presenting various elements of the learning environment used by participants and how they used these elements in teaching students. In the following sections, I analyse and explore what these findings mean for this research.

7.3.1 Highlighting elements

In section 7.1 of this chapter, I have described the elements that museum educators used while conducting programs for students, whether they were in the museum or in another venue. It was significant to note that Interactive components as an element was not used by participants during my observations. Increasingly, innovations in technology have transformed the museum experience (Bell, 2017). However, it is remarkable that despite being in a museum, participants wanted to provide students with an experience that could potentially be replicated in their school or provide a seamless integration to their usual curriculum. An additional element, natural environment (Bell, 2017) was also identified—an indication that museum educators are adept at using "place-responsive pedagogy" to "produce viable and valuable environmental educational experiences for students" (Mannion, Fenwick & Lynch, 2013, p. 793).

There is a gap in previous literature focusing on museum educator practices because there is a lack of detailed description on how various elements of the learning environment are utilised by museum educators for facilitating student learning. A review of literature indicate that no previous study has focused exclusively and extensively on elements used by museum educators. Many of the studies, some of which were cited in Chapter 2, only mentioned elements pertinent to educational activities that were under investigation (See for example Bell, 2017; Cramer et al., 2018; Downey et al., 2007; Hubard, 2015; Sedernerg, 2013; Oliver, Fergusson, Mahony, Oliver, Kingsley, & Browne, 2015; Tran, 2007; Winstanley, 2014). To generate a list of elements that museum educators used across different types of museums and in various kinds of student-related activities, I have had to use multiple sources.

This research has produced the different kinds of elements from the learning environment that museum educators used to facilitate deep learning. This is significant because it provides museum educators with an opportunity to see what other museum educators have been using. The list is an indication of other possibilities that they may not have considered using in the past. As Shulman (1983) stated, case studies are excellent opportunities to “pursue the possible, not only the probable or frequent” (p. 495). These findings also address Evans’s (1995) criticism that museums are underutilising and ignoring the opportunity to investigate the intersection between the learning environment and learning. It also has implications in the school context because as Newton (2009) pointed out, educators are not generally trained to perceive the relationship between the learning environment and effective teaching. Many of the types of elements used by museum educators reported in this study can also be found inside school classrooms (See for examples: Ahmed, Clark-Jeavons, & Oldknow, 2004; González-Vera & Hornero Corisco, 2016; Tondeur, Herman, De Buck, & Triquet, 2017). In the same way that the list provides museum educators with possible elements that they can use for teaching, the list also be used by school teachers to explore other types of elements that they may consider to use in school classrooms..

7.3.2 Pedagogical affordances

I am now going to advance the concept of pedagogical affordances. As stated earlier, I have adapted affordances as action possibilities (Hammond 2010; Heft, 1989; McGrenere & Ho, 2000; Turvey, 2012) arising from perceived and actual functional properties of an object (Pea, 1993). Based on data from this study, elements have specific affordances that museum educators, or other facilitators of learning, can exploit to support another person’s learning. I call these pedagogical affordances, which I define *as possible uses of an element of the learning environment to facilitate the learning of another individual*.

As expressed in the literature review in Chapter 2, although the theory of affordances has been applied in multitude ways and in many disciplines (Lindberg & Lyytinen, 2013), there is still a paucity of investigations on affordances in the museum field, in particular, how this theory applies to teaching and learning. This research may be the first to provide evidence of actualised affordances—how affordances were used in teaching practice, in contrast to perceived affordances, which was the focus of Young, Cleveland, and Imms' (2019) paper discussed in Chapter 2. To address this, I present a taxonomy[8] of pedagogical affordances illustrated in **Figure 7.15.**

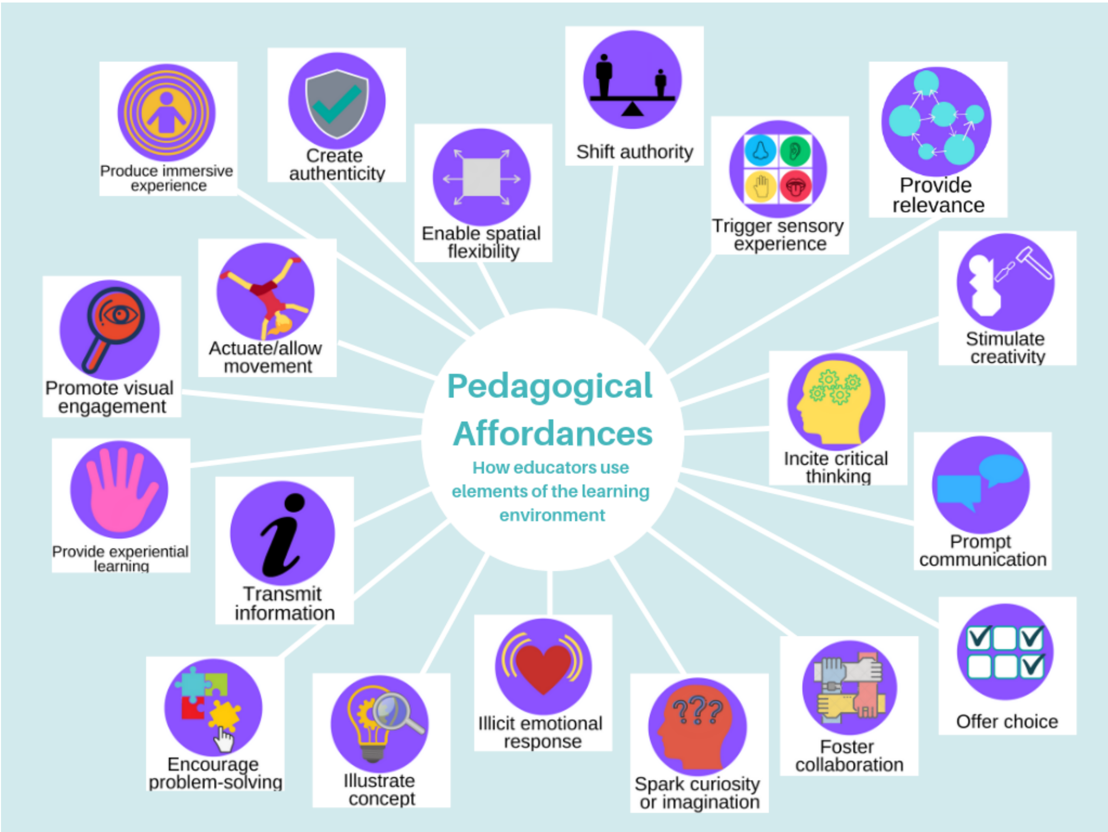


Figure 7.15. Taxonomy of pedagogical affordances (Villafranca, 2019a)

Findings presented in this chapter confirms Gibson's (1979) earlier assertion that it is possible for each element to have multiple affordances. These findings indicate two things. First, a single element may have a variety of affordances. For example, many of the participants used objects, such as a scientific specimen, for visual engagement. This supports Achiam et al.'s (2014)

[8] Although taxonomy is commonly used in the biological sciences, I used the term taxonomy instead of typology because the former represents classification of empirical entities—those that can be observed and measured. On the other hand, typology, which is generally used in the social science, is a conceptual classification.

study indicating that allowing visitors to touch and manipulate actual museum objects, promote active examination of said objects. Conversely, other participants used scientific specimens to engage students in critical thinking. This aligns with Del Gaudio's (2015) contention that personal encounters with real objects help in developing critical thinking, which in turn, enable individuals construct more concrete interpretation of the world and to perceive society as "something built by people" (p. 7.) Del Gaudio (2015) emphasised that this process is really important for the formation of the identity of young people, their transition into adulthood, and figuring out their role in society. This also confirms Hannan et al.'s (2013) study that engagement with real (versus digital) objects promotes teamwork, communication, and observation skills. The multiplicity of affordances in elements means that museum educators have multiple ways of using a single element to support student learning.

Second, the same affordance may be present in different elements. As Greeno (1994) pointed out, the existence of an affordance does not automatically lead to a specific use of the element. Instead, the affordances of an element are possible uses of that element. Participants utilised different elements for the same affordance. For example, to foster collaboration, participants used objects, technology, built environment, or macro spatial organisation. Another example is when museum educators used either technology or an object to prompt students to communicate. This means that museum educators have more options in terms of what they can use to prompt student actions.

The four factors of prior knowledge, prior experience, prior interests and choice and control that were highlighted in the personal context of the Contextual Model of Learning (Falk & Dierking, 2000, 2013) are highly relevant in the context of this study. The affordances that a museum educator sees and uses are a result of their *prior knowledge* and *experience* about that element or the use of that element for teaching. Their prior *interest* informed their decision on choosing that particular element, over one element or another, which is also influenced by the choice and control educators have over the use of that element and their learning environment. Additionally, findings from this study align with Heft's (1989) belief that affordance is context specific—that is, the "current state of both the environment and the individual" (Osborne, 2014, p. 69) influences the affordances that the individual uses.

Three key themes arose from museum educators using pedagogical affordances of elements to support student learning: they have a choice from a wide range of different elements that may be used for teaching students, each element may be used in a variety of ways, and they can choose from several types of elements in inciting different actions and reactions from students. These key themes will dovetail with other themes from the other two findings chapters and will be discussed in Chapter 9.

7.4 Summary

In this chapter, I provided analysis of the primary data sources such as program observations, excerpts from my research journal, and semi-structured interviews with participants that respond to questions on what and how participants used the learning environment to facilitate programs for student groups. I then juxtaposed these findings with relevant literature. In the next chapter, I present the findings focused on answering the research question centred on participants practices related to deep learning.

CHAPTER 8: SOCIOCULTURAL CONTEXT: MUSEUM EDUCATORS AND DEEP LEARNING

This is the final chapter reporting findings from my data collection and focuses on exploring deep learning as a concept and in practice. Findings in this section were derived primarily from observations, interviews, and my research journal. I also used audio recordings of programs observed, photographs of the learning environments and objects contained within, and teaching artefacts in writing the vignettes in this chapter. Similar to Chapter 7, I am presenting more broadly findings between the two case studies.

Findings presented in this chapter addresses this secondary research question:

> *What strategies do museum educators employ in using the learning environment to encourage students' deep learning?*

I organised this chapter into four sections. I start with an exploration of how participants understood the concept of deep learning. Then I identify general strategies they applied to encourage student's deep learning. Finally, I elucidate how they used the learning environment with deep learning strategies. I conclude this chapter by weaving together salient findings from the data presented and implications of these findings in my research.

8.1 Defining Deep learning

During the interview, I asked participants how they understood the concept of deep learning. I asked this before providing them with any information or definition of deep learning. Seven participants declined to respond to the question or acknowledged that they were unfamiliar with the concept. Participants responses could be grouped into two categories:

- Deep learning as something a student does.
- Deep learning as something the educator does.

8.1.1 Deep learning as something a student does

Based on some participants' elaboration, deep learning is a process undertaken by students. One participant explains:

> *It's that kind of understanding so you can get a sense of what things are in a descriptive way. But it's that they can take those one and see how it's connected to other things and that to make their own kind of deductions and draw conclusion from the knowledge that they're already understanding. That they've developed already and taking it to a whole new level where they can apply things and they can use it to inform other investigations. (Educator 23, Museum 8)*

It appears from this participant's statement that she viewed deep learning as a self-directed process, which builds on students' prior-knowledge and assists students in transferring this knowledge to other situations. Another participant's view aligned with this as well:

> *I think deep learning from students is when they like have a like eureka moment, like when they're discovering what might be a specimen, they come up with like an idea themselves so it might be like we help scaffold but in the end when they're like exploring, having a revelation, and it instils, like, I don't know, a wonderful, I guess, momentary experience and a memory. (Educator 7, Museum 4)*

A similar view is expressed by Educator 27. He thought that students engaged in deep learning will be able to find connections with what they are studying and their personal life. However, he expressed the need for museum educators to step back and allow students to pursue their own learning. He explained:

> *I think, for me, it's about stepping back from content, and for creating that space for learners to engage in content in their own time and in their own way, and not judging or assessing to a standard around that content. But*

you know, like, looking for the quality of those forces, like the quality of that collaboration, or when their thinking critically about something together, and that they can relate that to something real world or something personal or relevant for them. I think that's kind of deep learning of what I understand. (Educator 27, Museum 8)

This participant's description alluded to learning through self-discovery and use of elements of the learning environment to enable this process to occur. Another participant provided a similar response that involved students engaging with physical objects.

Curiosity. For them to look actually at the information, now all the information's not there but gets you into the mood, "well, here's other things we've thought all about, other stories, elements through the story" but by getting an understanding of where the objects being placed in the exhibit to tell that story. And that's you know, just one object can tell a story but put more objects in that cabinet you make a broader story. (Educator 3, Museum 3)

One participant explained the value of learning by doing and learning from mistakes for the process of deep learning.

Well, definitely not rote learning. I believe in students learning by doing. I believe in people learning by doing. You learn better by doing things. And making mistakes as you get along and correcting you remember better than someone telling you what to do. (Educator 15, Museum 5)

Another participant also mentioned the idea that deep learning is the opposite of rote learning. She expounded on the importance of providing hands-on and collaborative opportunities to support the process of deep learning.

I think deep learning is when a student has an opportunity to delve further into a subject, to have ideas reinforced and to explore different areas of interest rather than being told something or reading something once and *expected to remember it by rote. It gives an opportunity to revisit concepts and take it to another level and also in the museum setting, having that opportunity to have a hands-on and to actually interact with something is a much, I think, gives you deeper understanding because you have an opportunity to experience it in different ways. We also utilize group work because what you individually might get from a situation, everyone is going to have a different perspective and bring something new to the conversation so they're learning from each other in that environment as well. So, I think that adds on the deeper understanding of what's going on, something that they might not even thought of. (Educator 6, Museum 4)*

Some participants viewed deep learning as an ability or skill that students have or develop. One participant used her knowledge about Higher Order Thinking to make sense of deep learning. She said that deep learning allows students to find connections and draw comparisons from a range of evidence. She also pointed out that deep learning is more long term and cumulative, something that 'sticks' with the student even after the session and may be triggered when they see or read something relevant later on.

Deep learning is the learning they learn long after they've been here, I would say. It's the kind of learning that deploys often high order skills, not always, but often, I think. It enables them to make links and connections, comparisons, speculations, drawn on a range of evidence. Yeah but it's not quite the same as high order learning… I think deep learning uhm depends on the child very often uh their abilities but deep learning to me takes place when they go away with learning that they can then apply or compare or uhm even recall… I think often deep learning is cumulative. (Educator 4, Museum 3)

Another participant also interpreted deep learning as a student skill that enables them to transfer learning from one context into another.

I would just assume that it's just a chance for students to understand on a deeper level where they could apply that information in other subjects or cross-curricular. (Educator 8, Museum 4)

A third student-centric perception of deep learning was expressed as an outcome of applying what students learned. Examples of comments that reflect this view include:

For me, deep learning comes in their action. Uhm so uh what I mean is like if your students truly understand how it works. (Educator 11, Museum 5)

I guess that rather than just facts and information in the surface, where the information goes in and then quickly falls off again with prior knowledge or a resonance with other ideas or actually some kind of a paradigm shift in understanding of the world or a change in thinking and seeing. (Educator 18, Museum 6)

8.1.2 Deep learning as something the educator does

Several participants viewed deep learning as what they do for students. One participant said that what she does is meant to help students develop skills or competencies that students can use beyond the session in the museum.

Deep learning for me would mean that you've given the students an understanding or a new way of looking at something and a new skill that they developed that they themselves can use outside the museum, so you know something that they can walk away with for life. (Educator 5, Museum 3)

Another participant also considered the sessions in the museum as valuable for students even after they leave the museum. She viewed her role as someone who can assist students in finding connections with what they are studying and their life in general.

Deep learning is, ah, techniques that engage learners in history so that they achieve a comprehensive understanding of the time period of a person a place so that they have a comprehensive understanding of that, that connects with their prior relevant learning and that builds on their understanding of the world today. And their future. So deep learning is comprehensive in regards to the heritage site there in in. in my case my heritage site via a person a place a building that connects with their prior learning and understanding uhm in any prior learning or understanding in relation to that history heritage that gives them a comprehensive understanding that also relates to their life today. What does it mean for them today? (Educator 1, Museum 1)

Educator 15 also believed that helping students make connections is a critical part of what she does.

I think deep learning happens when you can make connections between various aspects of their learning. I might, for instance, take the students to see some bark paintings of the 1980s and get them to draw them first then use those drawings to connect to a contemporary work that where there may be some rock drawing in that contemporary work so that the student will then be able to make a connection between a more traditional type of artwork and a more contemporary artwork. (Educator 15, Museum 5)

Educator 17 understood deep learning as providing students with the opportunity to spend more time exploring the topic they are studying.

My understanding would be that learning that's focused more time is spent on the concept or idea. And there's more investigation around. Actually, digging deep into one idea or topic that the students are studying. Teaching is focused on deep acquisition of knowledge and I suppose appreciation of the topic. (Educator 17, Museum 6)

Similarly, Educator 20 said that deep learning involved going in-depth into a topic. He also mentioned that he took cues from students on whether he would go into more depth but that before doing so, he has already provided students with the basic information about the topic. He also said that he felt that it was important for him to keep students excited and engaged, especially those who already know more about the topic.

> *That's always been my focus, I have always tried to get the basics done to a, you know, a certain level. But if the children do lead to more complex topics, I will sort of expand on that but if there seems to be a good enough understanding with some of the students, I'll try to extend their knowledge as much as possible. I suppose a lot of times it is focused on, you know... general class. There are children that do know quite a lot of detail. So, I try to encourage them, covering myself as well getting much information as I can and keep them excited and try and well try not to lose the others (Educator 20, Museum 7)*

Similar to Educator 20, Educator 8 also took cues from students' interests in pursuing deep learning. He mentioned that his teaching approach aligned with the what students enjoyed doing. He also emphasised the need to keep students engaged and focused by igniting their curiosity.

> *I think deep learning is something teachers would have to feed off children and it sparks from children's interests. For example, if children liked to draw, then the learning would be facilitated through that method. I think that's my take of deep learning. (Educator 8, Museum 4)*

8.1.3 Museum educators' observation of students' deep learning

I also asked participants about signs that students in the sessions they conducted were engaged in deep learning. However, before I asked them this question, I spent some time to briefly explain to them the concept of deep learning briefly. I started by saying that deep learning is the process of acquiring skills that will enable students to apply knowledge learned from one domain into another situation (National Research Council, 2012). I also showed them an infographic[9] summarising the six deep learning competencies identified by the William and Flora Hewlett Foundation namely: effective communication, critical thinking and problem solving, self-directed learning, academic mindset, collaboration, and content (Getting Smart, 2013). Then I described what each of the competencies meant.

Most of the participants were able to identify specific indicators of deep learning, even though many of them were not familiar with the concept before my explanation. One such participant was Educator 9, who I observed conduct two different programs, one centred on space exploration while the other was about the Australian Gold Rush. He declared that he was unfamiliar with the concept of deep learning. Below is an excerpt from the transcript of our conversation.

> *Educator 9: Ooh I've never come across that concept before but what I perceive it to be, deep learning is the use of educational techniques that hmmm what is deep learning?*
>
> *Researcher: It's alright you don't have to answer if it's something you're not familiar with.*
>
> *Educator 9: Is it, I wanna not guess but I think I have an idea. Would it be …*
>
> *Researcher: And again, there is no right or wrong answer*
>
> *Educator 9: Is it like kind of going from the macro to the micro… no that's not it, that doesn't make sense. I wonder what it is. What is it? Am I allowed to know?*

I explained the concept of deep learning by saying that it is an approach to studying or to learning that students take and one good way to define deep learning is to explain what it is not. I added that it is the opposite of surface

---

[9] An infographic is a visual representation of information.

learning where students learn to recall facts, concepts, or procedures. I also said that deep learning will equip students with the ability to apply what they have previously learned in solving new problems. I clarified that it is not just learning about facts or information so that they can answer exam questions or regurgitate what they read. In short, it is not memorisation but understanding what they are learning and the ability to apply and integrate these into future problems. I also showed him the infographic from the Hewlett Foundation's Deeper Learning Initiative identifying the six deep learning competencies. The explanation seemed to have gotten him excited because he said that he was already doing what I described although he did not know what it was called.

> *Educator 9: Now that's… that's … I already do that! Now I know there's a name for it!*

I then asked him to describe how students in his two programs that I observed demonstrated deep learning. He said that of the two programs, the Gold Rush encouraged more deep learning, since the Space program was generally facts-based. In the Gold Rush, students were more encouraged to think critically through the characters they were assigned in the role-playing game. Some students collaborated with other students while others demonstrated creativity in order to get ahead in the game. He mentioned that the way the program was designed inherently encouraged students to engage in deep learning.

> *Gold Rush I think hits deep learning a bit more in that the kids are encouraged to… I mean the rules sheets aren't necessarily rule sheets, they're guidelines. They're encouraged to find ways around the rules sheet and make choices on their own. So, whenever a kid comes up and asks, "am I allowed to do this?". We just look at them and shrug our shoulders and say, "I dunno, are you?", and see how they respond. Or we'll go past the jail and go, "Hmmm is anyone guarding this jail? Interesting." And see how they respond to that. And so, from there, kids have gotten very inventive in the way they try to achieve the objective of the game. Some kids conspire with other kids to get people killed and things like that. Or marry certain people*

to get more money than marrying another person. And so those kinds of ideas and concepts. The way the program runs is kind of encouraging that kind of thinking. (Educator 9, Museum 5)

In the subsequent section, I cluster participants responses into the five categories that they believed were indicators of students engaging in deep learning: asking questions, communicating with others, collaborating, thinking critically and applying knowledge.

Asking questions

Several participants felt that when students were asking questions and the quality of their questions were indicators that they were engaged in deep learning.

> *"When students are asking questions like you are not the one asking the question, they are actually asking so why is that or what if we did this. You know what happens here, this is not working. They are engaging in it, if they were not engaging, then they wouldn't actually bother asking any questions at all. They would be like nah whatever, let's move on, you know, yeah. If you are really engaged in something generally there will be some questions generated in your mind based on the topic that is being addressed, and you can see that they are engaged whether their questions are relevant, what they are talking about and what you are doing at the moment" (Educator 15, Museum 5)*

Similarly, Educator 1 and Educator 8 both felt that asking questions implied students' desire to learn more about the topic.

> *So, there's through other physical behaviour or student questions asking for more information, that shows they are building on something we've just been talking about or looking at. (Educator 1, Museum 1)*

> *I think asking questions. They were definitely asking questions and wanting to find out more about specific information that they already knew about and they wanted to extend that further. They looked around the room to see*

if they could find any resources that would help them come to an answer themselves. (Educator 8, Museum 4)

Communicating with others

Other participants said that they saw students communicate with fellow students, not just when asked to share in class but also amongst themselves. Students were communicating with others, whether to share ideas or to articulate what they were learning. For example, Educator 20 said he sometimes heard students making the "ahhh" sound when students finally understood what he was teaching. He added that he also listened to conversations between students to gauge their understanding.

Because I try and show the same things in the different ways, I do have sometimes, you wait, and you show these different methods until the last one we hear the "ahhh…". The ahhh moments. They do verbalize that and they finally understand. So, you do hear individual conversations confirming an understanding. And it's you know with a shape of the dome you can always hear what they are saying anyways. (Educator 20, Museum 7)

Educator 1 also thought that students talking amongst themselves was an indicator that students were engaged in deep learning. She added that sometimes it was hard to stop conversations because students were too involved in the activity and were determined to complete their assigned tasks.

The trigger of understanding that deep learning is happening is that talk among themselves happened. So, when we look at that archaeology sheets, uhm, that discussion occurs. And it's hard to pull up, it's hard to stop and that's okay because it shows they are motivated at what they are doing and working through the task. (Educator 1, Museum 1)

Educator 7 also listened to students' conversations. She emphasised the value of students working in groups since these group conversations expanded students' knowledge because they were able to hear what their classmates know or think.

I think when you go around the different groups, and I guess, sometimes probe. Questions are generally… because they can relate to animals, they can touch, they come up with their own ideas, and I think like, a lot of the times, they will see the animals in a different light. And they're working together in a group, so they're working together within a group. So, they like to have to talk amongst each other. And also, I mean, because they present what they've been doing to the rest of the group. They can hear the ideas, and sometimes, you know, the (inaudible) often, things like they've not heard about animals and you know, learning about them. (Educator 7, Museum 4)

Collaborating

Aside from students communicating with each other, some were also working together. This was already mentioned in Educator 7's response above. Educator 8 also echoed this and said that students worked together while talking and exploring the objects they were given.

There was a lot of collaboration amongst students as well. So, they weren't just working on one activity individually. They were trying to work it out together even if it was putting the puzzle together but then there would be a lot of talk about it as well where they would be exploring what type of fossil it might be. (Educator 8, Museum 4)

Although, sometimes, collaboration between students had to be prompted by the participants or the way the activities were designed. For example, Educator 11 said that the program he facilitated required students to work in pair but also for everyone to work as a whole class to complete the assigned tasks. He ensured that students collaborated because collaboration is one of the 21st century learning skills.

Yeah, we always, with our workshop, we always try to make it collaborative because you know obviously that's one of the key skills for the 21st century learning. Yeah, we always have them working in groups or paired and stuff *to try and get through it. And also, I don't know if you got to see the Mars Rover section of it but the class, the whole class, actually engage in the discussion to try and problem solve the rover coming out of the ditch. (Educator 11, Museum 5)*

In the same way, Educator 14 also grouped students together and prompted them to ask their groupmates for help when they were struggling with something.

Yes, we always make sure it's a collaborative effort, no child is singled out, because it's not nice. I think mainly its bit too much pressure 'cause they are quite young. It's always or either a general or half-targeted question on children volunteering at that point but I always or if they're hesitant even for half a second, if they can't straight away answer then I say you can ask your moon friend for some help or what I even call starry friends because it's the rest of the class sitting on the floor being stars on the dark sky. Basically, things like that. (Educator 14, Museum 5)

Educator 27 also said that collaboration needed to be prompted. He said also said that applying what students were learning to create an output and then share their learning with another person makes the learning more meaningful. He added that he normally would encourage student to student learning by getting the student to teach another classmate what he just taught the student.

Yeah, that's... you've got to do that actively... it's much more meaningful if they put in the work, the hard work, and actually take what they've just... someone might have just learned and practices it and applies it. Because that's... that's an example of deep learning right there. Like, it's real world that you are... like if I say to someone, "Make this composite... digital photo composite." You're doing that but it's why? Why am I doing this? It's a bit abstract, you know. I'm making out that reason or whatever. But then, as soon as you say, "Well, teach your classmate or your friend," it's much more meaningful as a reason to be doing this. Yeah. (Educator 27, Museum 9)

Thinking critically

Some participants saw deep learning when students were able to respond to questions requiring critical thinking. For example, Educator 14 said that she engages students in both surface and deep learning, despite time constraints, by asking them questions that require critical thinking and some problem-solving skills to answer.

> *I would say it will be difficult for us to do a lot of deep learning, so I think our program is a combination of surface and deep learning, it's because we have less than ninety minutes that we have with them, so it's very difficult to achieve that within that time period. I do try to push along the line of deep learning as much as possible, and that is by sort of by engaging the student. I don't just give them facts all the time. For instance, in that program that you may have saw that would have been day and night, we engage in surface learning first, so we say, what is day what is night, then we say what is halfway in between and why, and I don't know if you saw the demonstration with the students, but they have to work it out, they have to work out what rotation of the earth will be, which way will they be facing, why it's going to be that way, and then why the answer is going to be sunrise* or *sunset. (Educator 14, Museum 5)*

Educator 4 said that she could tell that students were thinking critically through the kinds of conversations she was having with them or through the questions they were asking. This, to her, proved that students were formulating their own internal questions. She lamented, however, that it was not always possible to have these kinds of discussions with every student.

> *So there when I was asking questions about the dangerous toy… they're making the speculations and then a child I can't remember one of the children as we were walking down stairs, he was obviously processing it. He was the boy that said, "oh it could be a transformer and that those items could be an electrical transformer". So that to me is an evidence of deep learning because he is speculating about what they could be. So, to me that*

kind of follow on discussion is evidence on deep learning. The challenge I think is I can't have that discussion with every child in there. (Educator 4, Museum 3)

Applying knowledge

However, more participants thought that students demonstrated deep learning when they were able to apply what they learned in solving problems presented to them or through learning by doing.

For example, Educator 11, who facilitated a program that used an electronic robot kit called a mBot, which I described in Chapter 7, gave students several tasks to complete throughout the session. One such task involved getting their robots to create a square with its movement. This complicated manoeuvre required students to use a string of commands that would make the robot take several consecutive turns in a sequence. Students were taught how to make their robots to go straight and then turn left or right. However, they had to figure out for themselves that they needed to enter the command for going straight followed by three left turns to bring the robot back to its original position and, in the process, create a square pathway. She further explained that:

> *I think that whole applying the knowledge to a different situation. I mean, we don't just give the one challenge so there's also, well yeah, there's a challenge trying to get the mBots to do something when it notices a wall. So, them uh having their first experience in trying to just play with the mBots and having an experiment with it. And then problem solving the square. Okay it works with this way and like might be like the loop or something they learn about the loop or maybe they can do a loop or an if then conditional. (Educator 11, Museum 5)*

Educator 15 also thought that seeing students solve problems was an indicator of deep learning and that solving problems was one way of applying knowledge.

There are other ways of assessing whether students actually understand or whether they actually got it like deep learning, when you actually give them a problem to solve. You know it's not like information but application, However, directly say that quick way of getting whether they are engaged or not. (Educator 15, Museum 5)

Educator 10 said that by allowing students to learn by doing, they were encouraged to find answers for themselves instead of being told the solutions. This educator sees his role as a facilitator of learning.

In the sense where they are working the work and I see my role as, in that workshop, as giving then just enough information for them to figure out the rest of it. And I don't like to stand in the front and give a long talk. I'd rather they do it themselves and I'm always there to kind of answer questions if they see that, but I guess I see myself as kind of like another bit of a resource that they have available to them. (Educator 10, Museum 5)

Educator 26 also emphasised the value of learning by in encouraging students to apply what they have learned by creating an output.

I think that a lot of what we do here is asking them to do rather than to know. So, brainstorming questions, asking the kids to create something, to have a goal of something is really good. (Educator 26, Museum 9)

Aside from applying knowledge by creating an output, Educator 27 also said that the process of creating the output is equally important, especially if the process involved a conversation that prompted students to reflect on the process and the reasons for the decisions they made in completing their assigned tasks.

I think when students start to understand some of the work flow. So, it's not only they're working on a drawn portrait, for example, but when they start to think of, "Well, I can take a photo of that and publish it in this way and share it. And then, have a conversation with who I am sharing it with, why I drew it and what was and how. I think that, when they start to realize that *the process is really important. It's not just one thing in isolation but it's these network things. And I used specific explorers as an example of that with their 3D design using Tinkercad[10], they can import that into virtual reality and then, play with it at different scales so they can experience standing on their own 3D design in a life size… It's more about getting kids to understand the processes and the mindset of "you got to search these effective workflows out". Yeah, so I guess, you know, that session yesterday was art making but the important things they're learning are around that. Those workflows and processes and how-to… how to discover and use these processes. (Educator 27, Museum 9)*

8.2 Teaching for deep learning

In this section, I present strategies used by participants to encourage students in engaging in deep learning. As articulated in the Research Design and Methods chapter (Chapter 5), I used an observation checklist to keep track of elements, affordances, and deep learning strategies during each session. In the checklist, I initially had 12 strategies listed. These strategies, enumerated below, were adapted from factors identified by Biggs and Tang (2007) and Houghton (2004) that I customised for my study (see Chapter 2).

- demonstrates personal interest in the topic;
- brings out the structure of topic/subject;
- allows ample time to cover the topic;
- points out and corrects students' misconceptions;
- engages students in active learning through open-ended questions;
- presents students with problems to solve;
- chooses activities requiring thoughtful reflection;
- encourages students to combine different ideas;

10 Tinkercad is a free computer application for creating 3D designs, designing electronic circuits, and coding.

- builds on students' prior knowledge and connects to new information;
- cultivates a positive atmosphere that allows students to make and learn from their mistakes;
- affirms students learning from their mistakes; and
- clearly articulates intended learning outcome for the session.

During my observations and analysis, I discovered these four additional strategies:

- encourages students to articulate what they have learned/are learning;
- creates opportunities for collaboration;
- provides connections with the real world; and
- assesses learning through student's ability to demonstrate the application of knowledge and skills by creating an output

All 16 strategies enumerated above were used by museum educators. However, not all of these strategies were used with an element of the learning environment. In the subsequent section, I only discuss the 11 out of the 16 strategies that participants of Excursion into museums and Incursion into schools used together with an element of the learning environment because these directly respond to my research question on strategies museum educators employ in using the learning environment to encourage students' deep learning.

8.2.1 Points out and corrects students' misconceptions

Both Educator 20 and 24 pointed out and corrected students' misconceptions by using elements in the learning environment. Educator 24 was taking students through an immersive exhibition about the Gallipoli campaign during the First World War. British, Australian, and New Zealanders were sent to the Gallipoli Peninsula to capture what was then Turkey's capital, Constantinople ultimately. *Vignette 4: Broken teeth and toilets* below provides details of the short discussion she had with students when they stopped at one of the eight giant sculptures in the exhibition and then at a pair of recreated toilets in another part of the exhibition.

Vignette 4: Broken teeth and toilets

"What is he eating guys?" A few kids replied in unison, "corned beef!". "He is, right. And he's eating it on top of a hardtack biscuit. Who knows what hardtack biscuit was? Do you know why it's called hardtack?" One student replied that it is made of wood. "Well, it probably does look like wood, you're right, but it's actually biscuit. And it was baked to be so hard. There's no moisture in it that it wouldn't go off, basically. It's very very hard to bite into. It's not very very nice. You broke your teeth sometimes.

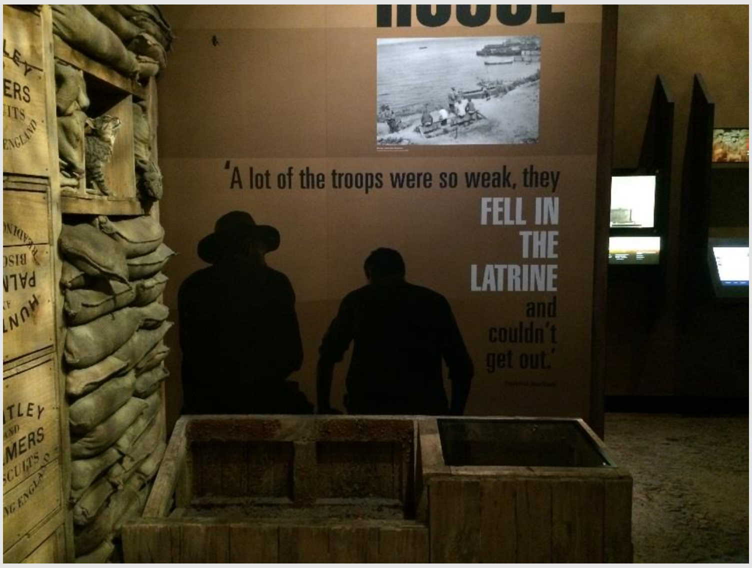


Figure 8.1. Recreated Gallipoli toilets

They also stopped in front of a pair of toilets. "What do we have modelled here? It is based on this photo.", she then points to a photograph of a toilet printed on the wall panel. She allowed the kids to explore the area surrounding the display of latrines. As the kids were exploring, she would respond to their comments and observations, especially when those were incorrect. For example, to a student who remarked on how big the toilets were, she said, “Well, they weren’t that big, really, they just made the model larger so you guys can see what they really looked like.”

Educator 24 corrected students’ misconceptions on specific objects in the learning environment that they were focusing on for the program. On the other hand, Educator 20 used elements in the learning environment to demonstrate the leap year, and in the process also correct a student’s misconception about Daylight Savings Time (see *Vignette 5: When a year takes a leap*). The elements he used included a torch or flashlight and a globe.

Vignette 5: When a year takes a leap

“How many days and nights does it take for Earth to orbit around the sun?” After a student said 365 and a quarter, Educator 20 responded with, “Three hundred and sixty-five and a quarter. Fantastic.” He continued, “Now, a quarter of a day is not a convenient number. Then he requested one student to stand up and pretend to be the “sun”, while he held a globe to represent earth and “orbits” around the “sun” by walking around the student.

He continued to explain how it would have been odd one night per year when just six hours after the clock hits midnight, the sun’s just coming up but then all of a sudden it is already another day. “So, you’ll have 365 normal days and one day that is only six hours long. And that’s ridiculous. So, we do something a little more sensible. And what is that thing that changes?” A student gasps loudly and blurts out “Daylight savings?”. “Well, daylight saving is a little different. Daylight savings is when we just change the time. So, nothing changes about the earth or the sun or even in space with daylight savings time.” After one student calls out the correct answer, he says, “A leap year. Let’s have a look at what a leap year is.”

He then went on to demonstrate (using a globe, a torch/flashlight, and the student representing the sun) how after orbiting around the sun for four years, the earth does not end up in the same place where it started and instead will be a full day away from its starting point. "And that is why we have a leap year".

8.2.2 Engages students in active learning through open-ended questions

Educators engaged students in active learning through giving students time to reflect and asking open-ended questions using elements of the learning environment. For instance, Educator 16 from Museum 6 discussed in Chapter 7, usually allowed students time to visually engage with the artwork (see **Figure 7.2**) soon after they sat down in front of it.

Another participant explained how she used animal taxidermies and open-ended questions to get a sense of what students were learning about the topic they were studying.

> *I like to - rather than stand in the front and talk - I prefer to ask questions and get them thinking so seeing the students coming up with ideas and putting forward their understanding is really important to me. So that's the way I approach it. Throughout the session, I start with an introduction but even in my introduction, I'm trying to initially gauge what they already know and then work from the level that they're at as well. So, for me, I think it's those opportunities to engage with them and ensure that they're getting the concepts. (Educator 6, Museum 4)*

8.2.3 Demonstrates personal interest in the topic

Educators who demonstrated personal interest in the topic in relation to an element of the learning environment engage in teaching for deep learning. In *Vignette 3: You crossed this bridge this morning!* in Chapter 7, Educator 16 remarked how he personally liked the painting because it "is not a made-up picture". The other participant who also showed interest or fascination with some of the things they were talking about was Educator 24, who took students through the Gallipoli exhibition (see *Vignette 4: Broken teeth and toilets*). This was what happened before they discussed the hardtack biscuit described earlier.

Vignette 6: Jack Dunn

"We are gonna go and see the next guy called Jack Dunn. Now Jack Dunn is one of my favourites, actually.", she started to say, but then had to remind students to move towards the side so that other museum visitors can come through the gallery. "I know it's a bit tricky guys, it's a confined space, it's true. You're doing very well." Then she continued, "Now, Jack Dun is a really great thing to look at because... oh, it's just very well modelled. And we're also going to have a think about flies."

8.2.4 Presents students with problems to solve

In Chapter 4, I described the multi-purpose gallery of Museum 5. This technology-rich learning environment enabled the museum to offer programs that strongly featured the use of various technological devices for teaching and learning. Many of the programs I observed in this museum also used these devices for deep learning, particularly by giving students problems that they must solve during the program. For example, in the preceding section on participant's observations of students' deep learning, I discussed how students in the program facilitated by Educator 11 had to complete specific tasks using their mBot and how one final task required a complicated manoeuvre students had to figure out on their own.

Another educator from Museum 5 who also used technology in providing opportunities for students to engage their problem-solving skills is Educator 10. His program involved the use of the Mars Yard, the museum's 140 square metres scientifically correct simulated Mars surface, desktop computers, microphones, webcam, and an LCD projector. Students were given a "mission". I narrate below Educator's introduction during the start of the program within *Vignette 7: Mission Unstuck*.

Vignette 7: Mission Unstuck

"Are we ready to start our mission?", Educator 10 started. This question was met with a resounding "Yes!" from the majority of the students. "We have a mission for you. We have our real Mars Rover down here. Let me try and get you our camera view." As soon as the video appeared on the two white screens in front of the room, students collectively gushed, "whoa!". "This is the real version of the one that you will be driving, and this is the real version of the yard you guys will be driving in. And the rover is in a bit of a situation." He continued, "It's stuck in those rocks there", while pointing to a section on the screen. "Now we'd like you to come up with a mission plan of … so you have just been going into those steps of getting the rover into each of those markers on your map. We'd like you to do the same thing but with our real rover mars here. So, what we'd like is to get the rover out of this rocky area and into this middle area right here." He continued to say that students will work with their partners for three minutes and come up with step-by-step instruction for the rover (i.e. turn left, drive forward, quarter turn etc.) then the whole class will discuss these plans together.

During the post-session interview, I asked Educator 10 about this program. He said that he saw his role in this particular program as someone who provided basic information but allowed students to figure out how to complete the mission mostly on their own. He saw his role as a facilitator for students' learning, rather than the 'expert'

I don't like to stand in the front and give a long talk. I try to get to the question and what we are going to spend the next 30 minutes doing but then as they're doing it. I'd rather they do it themselves and I'm always there to kind of answer questions if they see that, but I guess I see myself as kind of like another bit of a resource that they have available to them. They can use the maps that they can see in the front screen to ask questions about the robot or they could ask me what I think, or they can ask their friends what they think. I try as hard as possible to get them to do all of that thinking and not give any answers in that sense. (Educator 10, Museum 5)

8.2.5 Chooses activities requiring thoughtful reflection

Educators used the elements of the learning environment to select activities that required students to reflect. For example, one of the programs facilitated by Educator 9 used role-paying to introduce students to the Australian Gold Rush. Below is an excerpt from my journal briefly describing the venue and the program.

> The multi-function gallery was set-up to give the impression that students were in a gold mining town. There were several stations, such as a jail, bank, and store, arranged along the edges of the room. Except for the jail, most of these stations were mainly just tables with costumes, props, and laminated paper with instructions relevant to the station it represents. The jail, on the other hand, had four cushioned benches and five small hourglasses. The centre of the gallery was designated as the "goldfields" and had gold painted bottle caps as potential gold nuggets. Each student was assigned a role (banker, bushranger, digger, law officer, shopkeeper, doctor, etc.) and had to wear a costume representing their role. The costumes were sometimes as simple as just a red bandana for the bushrangers or a sash for the shopkeepers.

Figure 8.2. Australian Gold Rush stations

Figure 8.3. "Gold nuggets" as part of the Australian Gold Rush program

The program was intended to provide students with a glimpse of the challenging life during the Australian Gold Rush, albeit in a fun way, through the role-playing game. During the program, but towards the end, two female students (who were playing the role of male diggers) approached Educator 9 to ask him a question. I describe below their exchange.

Vignette: 8: Same sex marriage in the 1800s

"Can we get married?", the student asked Educator 9 while holding the hand of another student and gleefully jumping up and down. His response, "But you're both men" was met with grunts from both students. "Is that, remember in the 1800s, was that allowed in the 1800s?". The students replied, "no". Educator 9 continued to ask them more questions. "How did society feel about it?". The students paused before giving their response. He ended the exchange by remarking, "Not very nice, was it? If you liked someone of the same sex in the 1800s."

During the interview, I asked him about what aspects of the program he felt worked well. He said that immersing students in 1800 Australia, even if it was just a make-believe world, was a good way of getting students to experience a life different from theirs. While students had fun participating in the role-playing game, the immersion made them reflect more on the situations, which then led to a richer discussion towards the end of the program.

> *Having the interactive nature of the game worked really, really well. The kids respond to it. It's a great learning tool for them to kind of be immersed in a reality or in a world to have firsthand experience of the kinds of ideas that we are trying to share with them about life in Australia in the 1800s. And the discussions at the end is always interesting as well - the way they do a bit of question and answer. And so, kind of talking about things that happened and bring them to the forefront. It's interesting to see how the kids, you know, on one level it's just the fun thing that happened but then it's interesting for them to see for example some of the people escaping from the jail. It's interesting to kind of reframe that as rebellion and those kinds of ideas. And kids normally following the rules then presented with a situation where the rules aren't fair. If the rules aren't fair, the kids have to do something about it. So, is it good to be rebellious in a way? Those kinds of ideas and it's interesting to have those kinds of discussions. (Educator 9, Museum 5).*

8.2.6 Builds on students' prior knowledge and connects to new information

In the same way that Educator 16 purposely selected "Swanston Street from the Bridge", among hundreds of other works in the gallery, for his activity on urban landscapes, other participants also identified and included objects with which the students can relate. For example, Educator 5, informed me that she used an old wooden suitcase to help make the connection between early Western settlers in Australia and the lives of students attending the program she taught. She added that most students know what a suitcase is and most likely have used them during their travels. She used this familiarity to draw connections between what students know and have experienced with the experience of migrant families who also used suitcases to hold their valuable belongings when they travelled from their home country to Australia.

The suitcase is great for being in a family history, you know, one of separation and journey - that's all sort of any human being can relate to, I think. (Educator 5, Museum 3)

Another participant, Educator 2, led a program for a group of students studying Indonesia. She identified and stopped in front of objects throughout the various galleries of the museum that were relevant to Indonesia. Many of the students already knew a great deal of information about Indonesia. She encouraged students to share what they knew and continued to build on that knowledge by providing additional information. The following is a description of what happened when she and the students stopped in front of a set of Ramayana[11] drawings.

Vignette 9: The monkeys

After asking the students to turn their stools towards two ink drawings hanging on the gallery wall, Educator 2 began, "Now we are not going to draw this. I just want to call your attention to this." She motioned towards the ten drawings. "Somebody probably heard me talking about this before. What did I say this was drawn with?". A couple of students answered that the artworks were drawn using Chinese ink on English paper. This response seems to have delighted her because she remarked, "You're very good, you lot! Coz I said that to you whilst you were busy drawing something else and you still heard what I said, which was great." She continued, "Now this is all to do with the Hindu religion. What place are we in, where do they practice the Hindu religion in Indonesia?". A student gave an incorrect answer, and Educator 2 said, "No." When another student answered, she said, "Bali, that's right, this is Bali. Bali has a very rich culture of Hindu religion. How many gods do you think they have in

11 Ramayana, one of two great epic poems of India, tells the story of the journey of the Hindu deity, Rama (Encyclopaedia Britannica, 2018).

the Hindu religion?". Some of the answers the students offered included, "many", "they have a lot", "ten".

After a few more guesses, she continued to say that there are supposed to be a million and one Hindu gods in India. She explained further that Hindi originated in India but crossed over to Indonesia." There are all sorts of religious texts and stories. And one of those texts is called the Ramayana." She went on and provided the story of Ramayana in a nutshell. As she talks about the monkeys in the story, she points to the monkeys depicted in the drawings. "You can see the monkeys here up the top." All of a sudden, a student raised her hand to say that she has heard of the story before. "Can you tell me anything more about the story?", she encouraged the student. And the student continued to share the story with the whole class. Then another student added that a guy came to their school before with a puppet to tell the story of the Ramayana. "Oh, using those wayang puppets! Coz these characters are a bit like the wayang puppets in that they're a bit stylized with their arms a bit long." Another contributed more about the story, while Educator 2 listened intently occasionally commenting, "yeah, that's right.", "right" or "yes, yes".

During the interview, she remarked about this particular scene and expressed delight from the fact that students already knew a lot about Ramayana. Her ability to build on students' prior knowledge and connect this to new information using elements of the learning environment was evident in this example.

8.2.7 Cultivates a positive atmosphere that allows students to make and learn from their mistakes

There appear to be two types of positive atmosphere museum educators create during their sessions. The first one is about making learning fun and enjoyable for students. I noticed that two museum educators from Museum 3 who used the theatre to teach different programs both hid objects under the theatre seats for students to find. I asked Educator 5 why she did this, and her response was:

> *Well, that is a strange learning space. Being in the theatrette, so you know you wanna make it as engaging for as many people as possible so hiding objects or clues under the seats mixes it up coz people don't expect that. (Educator 5, Museum 3)*

Her colleague, Educator 4, also did the same thing. I described her session in Chapter 7 under the built environment. When I asked her about why she decided to use actual cameras and hide them under the seats, she said:

> *Yes, yes, so we had some training, maybe 18 months ago now, from an actor who has worked in museums. And he has talked about the variety of methods that you can use to create anticipation and to mix it up a bit. So, it's not just a presentation because, it is a presentation but what can you do then to make it active? Active learning as opposed to that passive learning. For example, some people say I asked a lot of questions so and that its bit like a talk show. One of my colleagues do a little bit of role-play and get children up and so at that point it's a bit like a little piece of theatre. I like getting the kids out to take a photo. I know I'm teasing them at that point a little bit. But I don't think it's setting them up to fail that I'm teasing. It's an "ohh, here's a learning point from it". (Educator 4, Museum 3)*

Hiding something for students to find was also employed by another participant from a different museum. She hid laminated photos of objects under students' clipboards, which seemed to have pleasantly surprised the students. The following is a transcript of our interview:

> *Researcher: I really like how, the photos that were hidden under the clipboards of the students, they discovered them and it's like prizes from under there.*

Educator 1: Yeah, yeah and that is something very new, its only in the last few months that I have been meaning to do that. It caught me a few weeks ago when I was rolling that out and that element of discovery and surprise is a drawcard in learning. So, yeah, it certainly is successful in just, you know, finding something underneath some clipboard.

The second "positive atmosphere" pertains to creating a "safe space" so that students are not afraid to make mistakes and learn from these. At the Learning laboratory (name of facility changed to retain anonymity) of Museum 9 educators, it seems that both the physical learning environment and the programs conducted there were designed to create this kind of atmosphere. For example, museum educators in the lab follow the fail forward concept, which is essentially applying what you learned from failure in executing your next move or moving forward from setbacks (Boston & Zhao, 2017). Educator 28 explained that museum educators model this concept by showing their vulnerability and articulating that they do not know the answer to every question a student asks. This show of vulnerability, he added, was a powerful way of encouraging students to be unafraid of the possibility of failure.

That's why I keep bringing back to this… to the learning community. It's a learning common, you know, where everyone learns from each other. And there's power in that, by just actually, by just being vulnerable and modelling that to students that it's okay to say, "Oh, I didn't know." And you're meant to be this special. That's really powerful for kids to see that, and particularly the kids that are afraid of failure or don't want to try because they think they're going to be wrong. (Educator 28, Museum 9)

Educator 28 was not only an educator in Museum 9's Learning laboratory but also designed this venue and developed the education programs offered to schools. He shared a little bit about the beginning of the development process. First, he described that the learning environment looked like a traditional classroom before they renovated it. He also said that the teaching practices within the old learning environment leaned more towards direct instructions.

Before we changed the space, they actually called it a classroom and it resembled a classroom. There were desks and lots of cardboards around the walls. They were holding on to the collection items and it reflected more like a direct-instruction teaching environment. The museum decided that it needed to change its learning offer. Not just the space, but its programs and everything.

He said that the impetus for the redesign was the museum's desire to adapt a more up to date pedagogical approaches and technology. He explained that he was selected for the job because of his previous experience in creating makerspaces in schools and innovative learning environments in social enterprises. Makerspaces are informal sites designed where people from varying age groups use digital technologies and traditional materials for the creative production of art, science, and engineering projects or to explore ideas, learn technical skills, and create new products (Sheridan, et al., 2014).

And a big part of that, or the first big part of that change is changing this classroom into an innovative learning environment or as we're calling it, "Learning Laboratory." All that the museum knew is that they wanted to utilise more contemporary pedagogies and technologies and try and catch up with what was happening in the education sector... They got me into design the space, select the educational technologies, and create the first release of programs. (Educator 28, Museum 9)

Figure 8.4 Museum 9's Learning laboratory after the redesign

He not only designed the physical structure but also selected the technology that were added as part of it and designed a new set of programs that was going to held in the Learning laboratory. Then he talked about the process for developing the programs for school groups. Although the museum gave him autonomy, he decided to hold consultations and collaborations with various members of the school communities. Results from these consultations served as the basis for the direction they pursued in designing the different school programs offered in the Learning laboratory. He mentioned anchoring the programs on 21st century competencies, taking a more learner-centred approach, and introducing the fail forward attitude.

> *It was kind of cool because I had the agility in the process because it was me basically doing most of it. I did liaise with others and consult with the wider communities. I ran a Think-tank, that's what we called that, which was teachers and principals and students from all over the country. They came for an evening and we talked about… Well, one is we asked them, "What do you guys think we should have in a museum innovative learning environment?" And that really confirmed where we were heading with it. The frameworks that I used to create it was based on what we had already been working in the education sectors. I brought 21st century core competencies, which they have now adopted their own version, which is kinda cool. The failing forward, like, risk taking. And I think most importantly, being learner-centric and I think that's still the process that they're going through now. Not just the lab but probably the whole education team. Because historically, here at this museum, it's been quite educator-centric, most of its learning offer. And that's just because of how it is. I think most people are… historically, people think that museums as being experts and I think that should be challenged.*

He also talked about "ako", which is a Maori concept that removes the hierarchy between the teacher and students as expert and learners. Then he described how they used students' individual interests to guide the direction of the lessons within each program. He emphasised the value of combining and shifting between both an object-centred approach and learner-centred approach in conducting the programs.

> *I think that we should be building off, well here they have this amazing concept of "ako". The non-hierarchical reciprocal learning relationship. It is embedded in the curriculum. So, I was trying to bring that into the lab and to create programs that were tapping, authentically tapping into the passions and interests of the learners to inform what happens in the session…*
>
> *And so, so what we were trying to do in the lab is tapping into those things that we are often so passionate about, and then go, "Ah, by the way, you like these? Have a look at this over here. This is from 200 years ago. Some are doing the same thing." I think that is a smarter approach to museum way because it's putting people at the same time. I think it's trying to balance collection-centred learning and people-centred learning. And, I think that's still a work in progress because most people in museums still… the majority still think of it as mainly collection-centric learning. I don't think it needs to be dichotomous. I don't think you have to go this or that, I think it can be both. But I think if we just keep going on about collection-centric learning, we're not serving a community anymore. And the reality of it is that the cross-section of the demographic that come to museums is really small still, for this museum at least. And so, we want to expand that. And so, this whole section of the community that we don't serve that well, like here in New Zealand, the Pacific Peoples. That informed how I wrote the programs. So, like one of the first programs are about Pacific explorers. We're just trying to do that. We're just trying to tap into Pacific cultures in an experiential, learner-centric capacity. And, yeah, I think it's pretty cool. (Educator 28, Museum 9)*

Educator 27 also explained that they encouraged the "ako" concept in education programs at Museum 9 by verbalising that they want to learn from each other and proclaiming that they, the museum educators, were not the experts. Instead, he added, that museum educators would say to students that they loved seeing both students and adults sharing what they were discovering and assisting each other.

> *Have you heard of "ako"? It's a Maori perspective on learning. It basically means a non-hierarchical learning situation. So, everyone is learning from each other simultaneously. And we explicitly say that at the start. We say, "We'd love to learn together and we're not the experts." We love it when people share their discoveries and help each other. And we love it when the adults and the teachers get involved. (Educator 27, Museum 9)*

It seems that other museum educators in Museum 9 also applied this fail forward or learning from mistakes concept on themselves when teaching programs. Educator 27 shared that after they finished conducting programs, he and his colleagues do a post-program reflection to think about what worked and did not work so that they can make changes for future programs.

> *My job is as much to facilitate those sessions as it is to adapt them and develop them and iterate on them. And a very important part of that session is post, like that immediate reflection on what worked and what didn't. (Educator 27, Museum 9)*

This practice of reflecting and making changes underscores the museum educators in the Learning laboratory' belief in the iterative nature of teaching. Almost all the Museum 9 programs in the Learning laboratory that I observed were taught by more than one educator. While putting away materials, equipment, and tools used and putting the room back into its "neutral" state, the educators had discussions about the preceding program they had just completed. Educator 27 explained that the post-program discussion with his colleagues was important as an encouragement to be more experimental and try new things.

> *The conversation around that and then the changes we make are really important. And I think, being adaptable myself, like sometimes, is being processes and bits of technology that I've thought has been quite successful.*

You've got to be prepared as an educator to let go of things, and also to listen to other people's ideas, and also experiment. It's not to be scared to try new things and fail, and not to be scared to do that in front of the learners. That really is embracing this fail forward ethos and being agile in terms of… and part of that is honesty. You know, saying to groups that come in, "Today, we're… this is a learning experiment. We're trying something we haven't quite done before and we're all gonna be learning different things together." (Educator 27, Museum 9)

This iterative approach to teaching the programs appeared to be institutionalised into the way the programs were designed and implemented in Museum 9. Educator 28 commented that they practiced quick reflection and immediate application of changes based on those reflections.

I think they normally did a really good job as they try to mix set up, and um, changing as they go and reflecting really quickly like even in one day or one assigned session. Based on this session, we've learned a lot from this session. (Educator 27, Museum 9)

Educator 27 added that this agility to quickly make changes required humility to admit mistakes as well as acceptance that museum educators or the museum programs are not perfect. The educators' ability to cultivate a positive atmosphere (make learning fun and safe) by using elements of their learning environment creates a setting that not only enable students but also staff to make and learn from their mistakes.

8.2.8 Encourages students to articulate what they have learned/are learning

There were many instances when participants of the study encourage students to verbally communicate what they already know about the topic they are discussing and what they are learning or have learned from the program. These were done through a number of ways, such as asking students open-ended questions as I have already expounded on earlier. Another approach was by asking students to pass on learnings to fellow students verbally. For example, I noticed Educator 27 repeatedly do this in several programs that I observed him facilitate. After teaching a new process to one student, he would tell this student to find another student to share what he just learned from the museum educator. The following is an excerpt from my research journal.

> Educator 27 started distributing three-dimensional (3D) viewers so students can see artworks from the museum's collection in their virtual gallery. He showed the same view on the large TV screen so that other students who didn't get a 3D viewer can also see what the others are looking at. He then talked about the concept of reappropriation of artworks. Then he told students to start working on their artworks using whatever technology and tools were available in the room they prefer to explore and use. He showed several students how to use the mobile phone in creating an artwork. He went to one student and taught this student how to use the mobile phone for creating images for augmented reality. After this, he asked that student to re-demonstrate the process to him. After he was satisfied that the student understood the process, he told this student to go and find another fellow student and teach that classmate what he just learned. The student gleefully walked away and found another classmate to share his newly found skill. Educator 27 did this a few times with several students.

Some participants put students into groups and allowed time for group discussions. Then each group had one or two students report their group's finding. Educator 7 did this with students in the program she facilitated. She even arranged the room to encourage students to engage in group discussion. She created a big empty space in the middle of the room and had students sit together in groups. Each group was given one taxidermy object to investigate and discuss. During the individual group discussions, she moved from group to group and threw provocative questions for students to think about. I describe below the beginning of this session from my research journal.

We are using the same room we used yesterday, but this was set-up differently. On one side of the room were two tables that had small plastic insects, scissors, pencils, modelling spatulas, and resealable sandwich bags. The other side of the room had a big open space in the middle with a few free-standing animal taxidermies. Along the bottom of one wall were three tables and a padded bench. On top of these tables and bench were more animal taxidermies, some fossils, and bones. Posted on this same wall were photos of animals and types of habitats as well as words such as herpetologist, mammologist, entomologist, etc. Students started arriving in the room, and Educator 7 asked them to sit on the floor in the open space. She asked students what they saw in the museum galleries. After two minutes, she divided the students into smaller groups and then gave each group one animal taxidermy. She told students to discuss the animals assigned to them. She spent the next five minutes moving from group to group sitting on the floor next to students, listening to the conversations and asking questions such as "how does it move?" or "What do you think they use that for?". Then she moved to the front of the room and called everyone's attention. She asked each group to select a representative or two to share with the whole class what they learned about the adaptation features of the animals assigned to their group.

During the interview, Educator 7 shared that she felt that giving students opportunity to get up close to these animals and discuss in small groups was a good way to encourage students to articulate what they know or are learning.

I think when they explore the Australian animals, in groups, I think they always open up. I guess because, it's empowering for the kids, I think, that they get to touch and feel, and come up with their own ideas. And they're familiar with a lot of the animals, not always, but mostly, familiar with them. I think, that part of the session worked really well.

When they're exploring the animals, I think when you go around to the different groups, and I guess, sometimes probe their learning by asking *questions. But, generally, because they can relate to the animals and they can touch them, they come up with their own ideas. And I think a lot of the times, they will see the animals in a different light. And they're working together within groups, so they're working together so they have to talk amongst each other. Also, because they present what they've been doing to the rest of the group, they can hear their ideas, and sometimes, you know, often, things that they've not heard about animals and learning about them. And they're touching the animals the whole time! They really like it. (Educator 7, Museum 4)*

Educator 23 did something similar for her programs. She gave a pair of students an object then let them explore and guess what that object was and what it was used for. She asked students to volunteer and put on World War I uniforms of soldiers or a medic. These replica uniforms and gears were specifically made to fit children.

I think that the putting on the uniforms and giving them some freedom to explore things, and then bringing it together and taking what they've learned whether individually or in pairs, or explored... not learned, explored. And then, taking those ideas and connecting them with the actual history and the stories of the various sort of people. (Educator 23, Museum 8)

When I said that I felt that after students put on the uniform, they acted as if they were playing a role, she remarked that:

Especially in that group, if they had a hat on, they felt like they were... they were that soldier or that particular character. Yeah, you're right. (Educator 23, Museum 8)

8.2.9 Creates opportunities for collaboration

Participants created opportunities for students to collaborate with elements of the learning environments in variety of ways, including putting them into groups or partnerships and completing tasks together. I have demonstrated this several times in earlier sections (see the following sections: Presents students with problems to solve; Encourages students to articulate what they have learned/are learning).

Another strategy that participants employed is by setting up the activity with elements of the learning environment to implicitly encourage students to work together. Educator 1, for instance, distributed different parts of broken objects among several students for their object documentation exercise. As students were completing their drawings, some of them realised that other parts belonging to their other classmates when joined with theirs completed an object. It also helped that students were not sitting in individual chairs or desks. Instead, they were working on the floor in an empty area in the middle of the room. They could see what their classmates were holding. I asked her about this in our interview:

Researcher: And another thing I really noticed is how the objects, there are fragments of objects from broken parts that make up one object.

Educator 1, Museum 1: Yes.

Researcher: And even without being prompted to talk to each other, they kind of realized, "oh I belong to a jar!". Was that intentional?

Educator 1, Museum 1: Ah! Oh yes, yes very much! Because that's the archaeological process. That typically, you find fragment as opposed to whole sections. So, we are trying to drive toward that as I sorta summarised it at the end of the program, toward the end that summary, that this is how an archeological dig site reveals its history and its human activities through fragments that are related to each other. Very deliberate, yeah!

Part of the "ako" concept applied by museum educators in Museum 9 is also encouraging students to work together. Educator 26 expounded on how they promoted collaboration between students by designing the program to include activities using elements of the learning environment that required two students to work together. In one of their museum programs, students rotate between stations to engage in various activities that the museum educators have created. The program was designed so that during the station rotations, the previous pair of students using the station were the ones who had to teach the incoming pair of students how to use the station.

> *We do a lot of getting the learners to teach each other and show each other how things work. So, we always have… we always try to have multiple different activities going on simultaneously. And one of the best examples of it is when we have virtual reality sessions going. We say very explicitly that there should always be two people on each station so that one person can be using it, and the other person can be assisting or learning from that person. And then, when it's time to change over, the person who's been assisting then gets taught by the person who has just experienced it. (Educator 26, Museum 9)*

In the same way that museum educators in Museum 9 applied the fail forward attitude to their teaching; they also collaborated closely with each other. Educator 27 explained that his personal experience of working in the film industry informed his attitude towards collaborative work. He remarked that he particularly enjoyed working with his fellow museum educators and even welcomed when the teachers of students helped in facilitating the programs.

> *Yeah, I feel like I draw my experience from filmmaking, particularly producing music clips and commercials and being involved in the production team of feature films. So that gave me a really deep experience in collaborating, and that's essential for this space – co-planning sessions because running concurrent activities using tech is really intensive. We can run it with two facilitators, but we love it when it's three of us working together and co-teaching that way. And we're really open to when teachers come in with big groups, planning with the teachers, and the teachers being involved in the facilitation and the delivery. (Educator 27, Museum 9)*

He elaborated on how they used technology to encourage collaboration between students. These collaborative encounters also inspire students to take risks and be more creative while prompting them to communicate with their peers.

> *Yesterday, we had a session around art-making using new technologies. I think part of that process is trying to maximise the opportunities where the learners are collaborating, and communicating, and being creative. So, those values and skills kind of drive a lot of the design of our learning sessions. I think for me, the key moments are where the participants are starting to work together, and the conversations between the participants about what they are doing, and where they've been successful or what hasn't worked. But also, just the very simple thing of participants taking a bit of a risk, trying something that had never been done before. And I think there was a few key moments where the teachers and the adults were as engaged as much as the younger learners as well. When that happens, we really love it! It's the teachers sort of modelling life-long learning, and the kids, they see that. The kids see the teacher's engaged and learning themselves, and like, "Ah! Yeah. I can do that too." (Educator 27, Museum 9)*

Educator 27 ended by emphasising that he believed that it was important for students to see their school teachers modelling collaboration and interest in continuously learning even though they are already teachers. Deep learning is fostered when there are opportunities for collaboration not only between students but also between educators.

8.2.10 Provides connections with the real world

There are multiple ways that participants in this study connected lessons in the programs with the real world. Sometimes the programs were connected to what students were learning back in their school. Other times, participants related their discussions and activities with familiar concepts within their community, heritage, or culture. Often, participants tried to align activities with the personal interests of students.

During the interview, Educator 27 shared three other programs they conduct in Museum 9 that I did not get to see during my data collection. For these programs, they drew on students' personal histories combined with real world information and provided them an assortment of technological devices and tools to create an output. For example, in one of the programs for Pacific exploration, they use virtual reality headsets to design a Maori water vessel called a waka. Some of the students who participated in the program have Maori heritage and the activity was one way that the museum encouraged these students to engage with their cultural background.

> *We have three different sessions around Pacific exploration. The movement through the Pacific Ocean of indigenous people discovering new islands and colonising new places. We go into migration theories. We go in and explore ocean navigation. And we… Ah! We do, specifically, we do waka design. And that's been really interesting because we do it in a way that makes it relevant for learners. Some of the learners that have come and done that have Pacific heritage but don't feel that engaged with their backgrounds and cultures. So, by offering some very modern tools, like 3D design as a way to explore the waka design, it's a bit of a motivator. (Educator 27, Museum 9)*

He also mentioned that they used the objects exhibited in the museum galleries as well as books to help inspire students in creating their designs.

> *For the navigation, we primarily use Google My Maps[12], which is another free web-based tool. And we get participants, for both of the sessions, start with an inquiry in the exhibition. With the waka design, they are looking for information that might inform their design choices. So, they go out on the floor in groups, takes photos, make a drawing of wakas, and read about*

---

[12] My Maps is a Google application that allows users to create customised travel maps with local pins.

ocean conditions. And then, they bring that back in here, and we have a bit of an ideation around what they've discovered on any exhibition. And then, hopefully, that conversation informs the designs that they make. (Educator 27, Museum 9)

I asked if they used the Surface tablets for that activity. He said that they did and that they also provided LEGO® as an alternative tool that students could use.

Yeah, the primary design is done on Tinkercad on the surface tablets, a free online program. And we do a kind of co-constructed demo of that. But we also offer just LEGO as another tool. (Educator 27, Museum 9)

I then clarified whether students get to choose what they want to use.

Oh, absolutely! Yeah, and we've got a couple of amazing books from the library around ocean voyaging. And we encourage them that it's as valid an option as using 3D designs is to use a book and do some reading and do some drawing. We all are involved in the inquiry part of that session. And then, when we come back, we make it clear that the participants have choice on current activities. Different ways of working. Sometimes, we find that participants might build something out of LEGO and then, go into Tinkercad and make a version, or they might be working in Tinkercad and get frustrated. We will go, "well, you could also draw your design, or you could join another team who's working together". (Educator 27, Museum 9)

He continued to talk about the other two programs, particularly the one centred on migration, where they asked students to map their own migration journey using Google's My Map. In cases where the student did not migrate from another country, they asked the student to focus on his or her journey from their house to the museum.

We, again, start with an inquiry, and we'll have to find out what some of that terminology means, and what migration means. We use maps on the *big touch tables, and often, if a participant needs some support, we will suggest that they make a personal migration story. Even if it's someone that's never left this country. It's like, "where did you come from today?" and we talk about mapping that journey. And then, we get into making a personal map using Google My Maps.*

As part of these programs, they also asked students to imagine how Polynesian people migrated from their home country (such as Tonga and Cook Islands) to New Zealand. Students mapped these hypothetical ocean travels through the Pacific Ocean using iPads and the touchscreen tables[13]. Then the museum educators helped students apply other online applications, such as wind maps, ocean currents, wave patterns, and live weather, to these maps. Applying real-time information on these hypothetical maps helped students in bridging past and present as well as their imagined journey and real life.

Part of the session is to make it a theoretical ocean journey, like, if someone was migrating from the Cook Islands, or Tonga, or where they would have travelled, and mapping that in the Google My Maps and dropping pins and marking it down. At the same time, if that's going on, we like to put up some of free wind maps on the big tables and they display live weather information, as well as ocean currents, and wave height. And so, we can start to talk about really what it would be like today. Making it kind of real world and current. (Educator 27, Museum 9)

Lastly, he talked about the program on navigation and how they used students' personal interests in motivating them to learn.

[13] A touchscreen table is a table that has a Light Emitting Diode (LED) display screen as its top surface. The LED display screen makes the table touch interactive for multiple users and removing the need to use a mouse or trackpad (think of touch tables as enlarged iPads placed on top of a table).

One thing we do with that one is, again, we personalize it. We don't assume that a learner coming into this space is motivated to learn about how Pacific explorers navigated. So, one thing we do in virtual reality is get kids to paint their own… create their own constellation in the sky. And then, we use that to, kind of, talk about stories of constellations and why they even have stories attached to these stars. And how the stars were used to determine direction when you're in the middle of the ocean. (Educator 27, Museum 9)

Educator 28 explained that these programs were learner-centred because they personalised what students were learning by linking these programs with the students' heritage or family history.

I think there are two ways to look at that particular program in terms of personalization and being learner-centric. We've had students coming through where they've got grandfathers and uncles who are master navigators. And so, shouldn't we be tapping into that knowledge? So, that's on one level. That's something to think about. So, rather than thinking we're the experts of waka Pacific vessels, maybe the people in the room can help us with that. So that was one level. The other level is doing a constructivist kind of approach. They're creating, they're learning by doing but within the framework of those 6Cs. They are collaborating, being creative, communicating, working together. And then there's a third way of looking at this personalisation tool, which is the sessions we run have concurrent activities. It's like choosing your learning activity. That's really important and it's not linear and it's not everyone looks at this; everyone creates a waka in Tinkercad; everyone puts it into VR. They have choice. They have choice on how they will approach certain content and why is it working. And, that's been an awesome challenge because most of the sessions that we run are for two hours. (Educator 28, Museum 9)

Another participant from Museum 9 also told me about one other program they offer that I did not get to observe. In this program, students were given smartphones or a camera that is capable of capturing 360-degree images before they were sent to the museum's exhibition on World War I. While in the gallery, students used the smartphones or camera to capture theirs or their classmates' emotional response to the exhibition. These images were then shared during the class discussion back in the museum's Learning Laboratory. These images served as starting points for the discussions on emotions—how people during the war felt and how students themselves felt while viewing the exhibition. Finally, students used an iPad with a three-dimensional scanning camera to capture "statues" of students showing their emotional response. He remarked that these activities were well received by students and he felt that it was a good way to illicit students' empathy for others.

> *In the Gallipoli program, the first task is basically we give them a smartphone and we ask them to go into the exhibition and capture a 360-degree image using a Google camera of some of the people or moments within the exhibition as a way to kind of capture an instantaneous experience inside the exhibition. And then to think about the people who experienced the war and to think about their emotional responses and ask the learners about their emotional response to Gallipoli. And so, they come out and they share what it is that they saw. They share the 360 degree images and we discuss how useful it is as a way to share experience. And then, we talk about... we get them to discuss the different emotions of war and what people felt experiencing it, and how they themselves felt experiencing the exhibition. Then, we use an iPad with a 3D scanner attachment, and we ask them to embody emotions and 3D scan each other to, basically, capture virtual statues of themselves in some kind of emotional response. As a way to capture their experience and their empathy for people's experiences in war but in a way that's not limited by the words that they feel comfortable using. That's been incredibly successful. (Educator 25, Museum 9)*

8.2.11 Assesses learning through the student's ability to demonstrate the application of knowledge and skills by creating an output

Several of the participants encouraged students to create an output as a way to demonstrate their new skills or knowledge. One of these participants is Educator 25 who asked students to identify a problem then propose a solution. First, she discussed with the whole class the what they were going to do that day. She used a white board to write down the different steps in the process for exploring a problem and coming up with a solution. She emphasised that students could use any of the tools and resources available in the room in creating their proposed solutions. Then she divided students into smaller groups. These groups brainstormed about potential problems and solutions that they wanted to pursue. They used a table with writeable surface during their brainstorming exercise. Finally, students dispersed and worked individually, in pairs, or in groups to create their proposed solutions. Below is a description of her program from my research journal.

> Educator 25 explained to students that their task was to find a problem they are concerned about then find a solution for it. Students were told that they could use and may access everything in the room that they needed to complete this task. They engaged in a short whole-group discussion before breaking up into smaller groups to brainstorm further. Then students individually, in pairs, or small groups went off in different directions to start working on their own. I was amazed when one student, who was perhaps eight or nine years old, collected what he needed from the cupboards. He proceeded with setting-up an iPad on a tripod, drawing and writing on the writeable table's surface, and, finally, shooting his stop-motion video.

I witnessed different students work independently or collaboratively. I also saw students select tools on their own. I was particularly impressed with one student who created a stop-motion video using an iPad, a tripod, and the table's writable surface. The student did this on his own. I shared my astonishment about this particular activity with Educator 25, and she remarked that students enjoyed making stop-motion video as they did not seem to view this as an academic assignment.

> *I love stop motions! The program is so easy to use and so simple. I'd often say, "okay, well, let's explain this next then how about explain this with stop motion?". They love it! They love it because they don't see it as an assignment. They see it as making a movie! (Educator 25, Museum 9)*

Educator 7 also shared that another way that she used technology in demonstrating what they have learned is through mock interviews. In this activity, she asked students to record as they interview each other while pretending to be scientists commenting on climate change.

> *I do use technology in one part where I'm... which is, climate change, and Australian animals. So, the kids they do a little mock-up interview – pretend that they're a scientist. And that gets recorded and gets sent back to the teacher so that they can listen back to what they did in the museum. And in school, they get to do research further. (Educator 7, Museum 4)*

8.3 Discussion

In the preceding sections, I presented findings that respond to this research question:

> *What strategies do museum educators employ in using the learning environment to encourage students' deep learning?*

In the succeeding sections, I analyse and explore how these findings relate to literature.

Data presented in this chapter confirm that museum educators in this study use the learning environment to support students' deep learning despite the fact that many of them were unfamiliar with the deep learning concept. Although some provided an explanation, collectively, they did not have a common definition of deep learning. This finding is consistent with a study by the William and Flora Hewlett Foundation (Hattaway Communications, 2017), where participants offered different ways of explaining the deep learning concept. However, after I briefly explained the concept, most of the participants were able to identify evidence of students engaging in deep learning in the program that they recently facilitated.

Interestingly, all the participants used some deep learning strategies while teaching, including those who said outright that they did not know what deep learning was all about. These findings indicate that regardless of their level of understanding about deep learning, museum educators who participated in this study employed strategies the support students' deep learning. This is critical because as Smith and Colby (2007) found, while deep learning may happen accidentally, educators must understand and intentionally apply practices that would lead to students' deep learning. If museum educators were to become more aware of the deep learning concept and how they could use the elements to facilitate deep learning, then they may be able to make deliberate decisions in maximising potentials of the learning environment for developing students' deep learning.

In Chapter 3, I compared Houghton's (2004) list of factors that teachers can consider in encouraging students' deep learning with that of Biggs and Tang's (2007) list. While the two lists were valuable in providing a starting point for investigating what teachers can do to support students' deep learning, neither authors provided explanation or descriptions of these factors. Additionally, these lists were not specifically designed for investigating deep learning and the use of the learning environment. Nevertheless, in Chapter 5, I combined the two lists then operationalised them into 14 observable strategies. While all 16 strategies were observable in museum educators' practice, only 11 were used with an element of the learning environment.

Findings from this study provides empirical evidence that museum educators use elements of the learning environment as part of their deep learning strategies. This is consistent with the report by Mahat et al. (2017), which discussed teachers' perceptions of the types of elements in the learning environment that contribute to enhancing student deep learning. In their study, teachers identified spatial attributes/features (such as reading nooks), moveable furniture and fit outs (such as writeable tables) and tools and materials for hands-on activities. These elements encouraged deep learning through opportunities for collaboration and engagement and by offering a range of experiential learning experiences for students (Mahat at al., 2017). In the current study, museum educators used objects (such as artworks, scientific specimens, artefacts, cultural and archaeological materials), technology (such as laptop, surface tablet, 3D camera, VR headsets, iPAd, mobile phones, microphones, DSLR camera), images and videos (such a printed photographs, digital images and videos), text (such as introductory panels, object labels, captions, narratives on gallery walls, laminated papers containing words, song lyrics), built environment (such as seats bolted on the floor, observatory dome, architectural details of buildings, immersive exhibition), natural environment (such as trees, hills, sky), sensory stimulus (such as smell, sounds, educator's voice, audio recordings, lights), and spatial attributes (such as blank spaces, physical arrangement of elements/display) to encourage students deep learning.

For the most part though, as pointed out in Chapter 3, studies on deep learning tend to focus on teachers' strategies for students' deep learning (See Warburton, 2003; Biggs & Tang, 2007; Smith & Colby, 2007; Mahat et al., 2017; Martin & McGrath, 2015; National Research Council, 2012; Fullan et al., 2017; Fullan et al., 2014; Fullan et al.,, 2018; Huberman, et al., 2014; Lampert, 2015; Mehta & Fine, 2015; De Monte, & Donehower, 2017; Education Writers Association & William and Flora Hewlett Foundation, 2017; Guerriero, 2017) but neglect to include how the learning environment figures in these strategies. This study fills that gap by offering detailed descriptions and examples of how elements of the learning environment may be used to support students' deep learning. Data from this study also aligns with Fullan et al.'s (2018) contention that it is not the structures of the physical learning environment but the way these are used to intentionally support students' deep learning that makes a difference.

Similar to pedagogical affordances, discussed in Chapter 7, one type of element may be used in multiple strategies for students' deep learning and one strategy may involve use of multiple elements. For example, for an element that used for different strategies were objects installed in the exhibition, specifically the giant sculptures of First World War soldiers in Museum, which Educator 24 used to point out and correct students' misconceptions and demonstrate her interest in the topic being discussed. The same sculptures were also used by Educator 27 in connecting what students were learning with that of the real world. In the same way that an element may have multiple affordances (Gibson, 1979; Norman 2013), these affordances translate into multiple strategies that educators can use to enhance deep learning in students.

Many of the strategies identified in this study are also consistent with some of Merrill's (2002) five principles for designing successful instructions discussed in Chapter 4. In particular, Principle 1 (learning is promoted when learners are engaged in solving real-world problems) aligns with presenting students with problems to solve, providing connection with the real world, and assessing learning through the student's ability to student's ability to demonstrate the application of knowledge and skills by creating an output. Principle 2 (learning is promoted when existing knowledge is activated as a foundation for new knowledge) supports building on students' prior knowledge and connects to new information. Principle 4 (learning is promoted when new knowledge is applied by the learner) is aligned with presenting students with problems to solve and assessing learning through the student's ability to student's ability to demonstrate the application of knowledge and skills by creating an output. Lastly, Principle 5 (learning is promoted when new knowledge is integrated into the learner's world) supports providing connection with the real world.

The single factor, social mediation within the group, that was highlighted in the sociocultural context of the Contextual Model of Learning (Falk & Dierking, 2000, 2013) is highly relevant in the context of this study. The strategies that a museum educator employs are contingent upon *social mediation within the* *group* regardless of whether these mediations between museum educators and students, student and students, and museum educator and museum educators.

Three key themes arose from museum educators use of the learning environment to support students' deep learning: they are able to identify when students are engaged in deep learning, they use the elements in the learning environment in strategies for students' deep learning, and each type of element may be used in different strategies. These key themes will be consolidated with other themes from the two findings chapters and will be discussed in Chapter 9.

8.4 Summary

In this chapter, I provided an analysis of the primary data sources such as program observations, excerpts from my research journal, and semi-structured interviews with participants which responded to the research question focused on understanding and practices related to deep learning. I ended this chapter with a discussion of the empirical findings and correlated these with the literature. In the next chapter, I deliberate more deeply on the implications of this study on teachers' classroom practice and expound on Curated learning as a pedagogical approach to support students' deep learning.

CHAPTER 9: CURATED LEARNING

In Chapters 6 to 8, I presented the analysis of data from this study. These chapters investigated how museum educators used the learning environment in supporting students' deep learning. Specifically, I analysed data from program observations, excerpts from my research journal, and semi-structured interviews to understand where museum educators taught school groups, what they used for teaching, and the deep learning strategies that they employ using elements of the learning environment.

In this chapter, I present a general discussion of the findings from the study to respond to the primary research question:

> How do museum educators maximise the use of their learning environment to facilitate students' deep learning?

I advance the concept of Curated learning as an approach that museum educators employ in maximising elements of the learning environment to support students deep learning. I open this chapter by explaining Curated learnings' theoretical and practical links to the practice of curating in museums. I continue with an articulation of the five principles underpinning Curated learning and articulate which deep learning competencies each principle promotes. I close this chapter with a brief summary of what has been covered within.

9.1 Why Curated learning

Based on findings from this study, museum educators maximise the use of their learning environment to facilitate students' deep learning with what I describe as 'Curated learning', which I define as a pedagogical approach that involves purposeful selection, manipulation, and use of elements within a learning environment to set-up conditions for students' deep learning. Curated learning highlights the role of the museum educator in supporting students in enhancing their deep learning competencies. Furthermore, this approach acknowledges that the learning environment also plays a role in enabling museum educators in setting up these conditions. Pedagogy in this study adopts and aligns with the definition proffered by Murphy (2008). She defined pedagogy as "interactions between teachers, students, and the learning environment and the learning tasks." (Murphy, 2008, p. 35). I will unpack the concept based on this study's three secondary research questions, namely: a) purposeful selection of learning environments; b) use of elements within the learning environment for teaching; and 3) strategies using the learning environment to promote students' deep learning.

In the museum world, curation is generally understood as telling stories through careful selection, organisation, interpretation, and presentation of objects in an exhibition (Robins, 2005; Wolff & Mulholland, 2013). The curatorial process is usually undertaken by a museum curator. I argue that museum educators also follow this process when they facilitate education programs, particularly for school groups. This is evident in my findings, for example when participating museum educators selected locations within the museum galleries to create their micro-learning environment, in their arrangement and use of elements within the venues allocated to them, and in adding or removing elements to suit the teaching and learning approaches necessary for them to attain the learning objectives.

In the context of this research, the learning environment is not just the physical location where the museum educator teaches (Leander et al., 2010) but includes the interaction between the physical, digital, personal, and sociocultural, "real and imagined" (Soja, 2014, p. 177) components of the space. In Chapter 6, I showed evidence that museum educators who participated in this study sometimes taught in venues that they have not seen or have chosen. Despite this, they were still able curate the learning environment to suit their requirements for the program as well as the needs of their students. There were also instances when they had to use public spaces, which they shared with other museum visitors and museum educators. During these times, they applied the curatorial process by selecting and creating micro-learning environments. This study has provided empirical evidence of a learning environment that departs from the traditional notion of a classroom-as-container that has dominated the field of educational research (Leander et al., 2010). It has also presented data to further challenge the notion of an "imagined geography" discourse in education, which essentially prescribes when and where researchers expect learning to happen (Leander et al., 2010, p. 329).

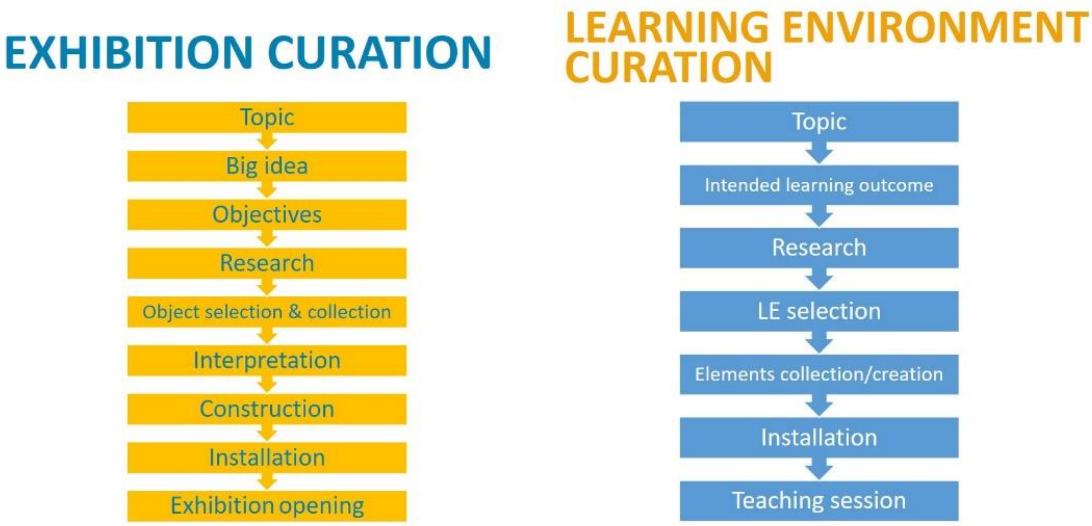


Figure 9.1 Exhibition curation versus learning environment curation

Figure 7.1 compares the process of curating an exhibition and curating a learning environment. I present a simplified version of the exhibition curatorial process (Robins, 2005; Villafranca et al., 2017; Wolff & Mulholland, 2013). Generally, the curator starts with a topic then develops big ideas followed by objectives before conducting further research. Objects that will help tell the story of the exhibition are subsequently selected. Sometimes, further research is undertaken to help with the interpretation. The exhibition gallery is prepared along with everything that will be included in the exhibition, such as labels, panels, and technology. And finally, you have an exhibition.

The process for curating the learning environment is quite similar. You begin with the topic or learning unit then identify the intended learning outcomes. Perhaps you will do a bit of research on the types of learning activities that will help you achieve the learning outcomes. After you have those outlined, you can start identifying elements you will need to curate your learning environment. Then the process begins again when the topic or the intended learning outcomes changes. One important quality of Curated learning is its iterative and continuous nature; it is a continuous process of selecting, manipulating, and using objects and spaces within the learning environment. This is because when the intended learning outcomes change, so should the learning environment.

Some museums that have permanent exhibitions eventually change these to remain relevant to the changing society. Sometimes entirely, other times just parts of an exhibition are updated. The same principle should be applied to learning environments. To be clear, I do not mean a physical refurbishment of the facility. Perhaps changing the seating configuration from one that accommodates whole class discussion into a space that allows for collaboration and even individual reflection. Or maybe completely changing the location for a particular session. The key here is changing the learning environment to suit the pedagogy instead of the other way around. As Sommer (1977) pointed out, there is no ideal classroom layout that will be suited for all activities.

Essentially, in a classroom context, Curated learning could involve selection, manipulation, organisation, and use of teaching aids, objects, visual displays, visual and textual instructions, seating arrangement, desk location of teacher and student, textual and visual prompts, technological devices and equipment, and resources contained within (i.e. books, art materials, iPads, laptops, etc.) to support the pedagogy employed to achieve specific learning outcomes.

In the context of this research, deep learning is, in general, the ability of students to apply what they have learned from one context into another (NRC, 2012). Deep learning is also viewed as a process undertaken by students to develop competencies that will enable them to thrive in this rapidly changing world (Chow, 2010; William and Flora Hewlett Foundation, 2013; Warkentien et al., 2017; Fullan et al., 2018). Data presented in Chapter 8 confirms Smith and Colby's (2007) assertion that educators can intentionally adopt learning strategies to encourage students' deep learning. Findings from this study indicate that museum educators use the learning environment to employ the following 11 strategies to support students' deep learning:

- Points out and corrects student's misconceptions
- Engages students in active learning through open ended questions
- Demonstrates personal interest in the topic
- Presents students with problems to solve
- Chooses activities requiring thoughtful reflection
- Builds on students' prior knowledge and connects to new information
- Cultivates a positive learning atmosphere that allows students to make and learn from their mistakes
- Encourages students to articulate what they have learned/are learning
- Creates opportunities for collaboration
- Provides connections with the real world
- Assesses learning through students' ability to demonstrate application of knowledge and skills by creating an output

In the three previous chapters, I laid out findings related to the learning environment. Throughout these chapters, I have explored different types of physical learning environment where participants conducted the museum programs (physical context), how the participants used the elements in the learning environment for teaching (personal context), and the strategies that museum educators used to support students' deep learning (sociocultural context). The findings, seen through the lens of Falk and Dierking's (2000, 2013) Contextual Model of Learning, provide a synthesis of key themes that can be distilled into the six principles of Curated learning. These principles, which I call the 6Cs of Curated learning, are intended to assist educators in using elements within their own learning environments in ways that empower students to develop their own deep learning competencies that, ultimately, will help them succeed in their academic, professional, and civic lives. The six principles are listed below:

1. Connected: Students' deep learning is supported when educators use the learning environment for connected learning.
2. Collaborative: Student's deep learning is supported when educators use the learning environment to promote collaborative engagements.
3. Continuous: Students' deep learning is supported when educators use the learning environment to encourage continuous learning.
4. Creative: Students' deep learning is supported when educators use the learning environment creatively.
5. Combined: Students' deep learning is supported when educators use the learning environment to suit a diversity of pedagogies, strategies, resources, and students' needs.
6. Constructive: Students' deep learning is supported when educators use the learning environment to create an atmosphere that is conducive to the construction of learning.

I expound on each of these principles in the following section.

9.2 6Cs of Curated learning

For this study, I investigated practices of museum educators to draw out strategies that school teachers can adapt in their classroom practice. In this section I discuss the six principles that underpin Curated learning. I also provide links of each principle to deep learning competencies that it supports. In outlining the six principles, I am advancing Curated learning as an approach that may be utilised not just in the museum setting but also in other learning environments such as schools.

In Chapter 2, I presented deep learning competencies promoted by the Deeper Learning Initiative (DLI) (William and Flora Hewlett Foundation, 2013) and the New Pedagogies for deep learning (NPDL) (New Pedagogies for Deep Learning: A Global Partnership, 2019) (See: **Table 2.1**). I also discussed the similarities between their lists. Both include communication, critical thinking, and collaboration. The competencies offered by DLI seem to have more of an academic focus. Conversely, those of NPDL appear to put emphasis on competencies that can help students succeed beyond their academic life. For example, one of the NPDL competencies include creativity, but leaning more towards entrepreneurship and for economic and social impact. Additionally, citizenship is also included, which points to developing students as responsible global citizens.

If deep learning is supposed to enable students to thrive in this highly complex world as well as succeed in school, their civic life, and future professions (Chow, 2010; William and Flora Hewlett Foundation, 2013; Fullan et al., 2018) then it makes sense to consolidate the competencies offered by both DLI and NPDL. For example, global citizenship and creativity, two competencies that were only included in NPDL's 6Cs of deep learning (New Pedagogies for deep learning: A global Partnership, 2019), are two important competencies that needed to be added in the consolidated list. Content mastery, a competency listed only in DLI's list (William and Flora Hewlett Foundation, 2013), also needs to be added in the consolidated list. On the other hand, some of the competencies from both organisations should be combined together as they pertain to very closely related competencies. For example, Self-directed learning and academic mindset from DLI and Character were combined as Positive outlook on learning. Below are the seven consolidated deep learning competencies:

1) Effective communication
2) Critical thinking and problem solving
3) Positive outlook on learning
4) Collaboration
5) Content mastery
6) Creativity
7) Citizenship

In the subsequent section, I will map the six principles of Curated learning against these seven competencies that I have already mentioned in Chapter 3. I am mapping the competencies against the 6Cs to demonstrate how Curated learning supports these deep learning competencies.

9.2.1 Connected: Students' deep learning is supported when educators use the learning environment for connected learning

The first principle of Curated learning is that it is 'connected' to students' personal, academic, and civic lives. This means that their learning environment, the tools they are using, and the lessons they are studying are aligned with their personal interest or relevant to what is happening in their community, country, and the world, or both. An example of this was discussed in Chapter 7 when Educator 16 specifically chose a painting depicting a road that the students would have crossed that morning on their way to the museum. More examples were discussed in Chapter 8, when museum educators used the learning environment to provide connections between what students were learning and the real world, such as when they used technology to help students connect with their cultural heritage and personal history, and when students were prompted to demonstrate what they knew about climate change.

This principle is in line with results from the study undertaken by Martinez and McGrath (2015) which found that learning was connected to broader themes and concepts that cut across multiple subjects instead of being taught in separate subjects. For example, many of the programs taught by museum educators in this study were interdisciplinary and required students to draw knowledge learned from different subjects. Data presented earlier in this thesis, also support Martinez and McGrath's (2015) observation that deep learning is cultivated when students were encouraged to apply what they were learning to solving real-world issues and problems because "Everything is related. Everything matters…" (p. 18). Data from this study also support Hattie's (2013) contention that making requires connecting new information with what students already know since museum educators in this study built upon students' prior knowledge in introducing students to new concepts and information. An example of this was when museum educators chose objects and technology that students were already familiar with to be used during the program.

Based on data from this research, educators can create a connected learning environment by demonstrating personal interest in the topic they are teaching. They should also engage students in active learning through open-ended questions. By choosing activities that prompt thoughtful reflection and require solving problems drawn from real life, they will be building on their students' prior learning and help them effectively connect these with new information.

The strategies from findings in this study will help develop the following deep learning competencies of students:

- Positive learning outlook
- Critical thinking & problem solving
- Effective communication
- Content mastery
- Collaboration
- Creativity
- Citizenship

9.2.2 Collaborative: Students' deep learning is supported when educators use the learning environment to promote collaborative engagements

The second principle of Curated learning provides opportunities for various collaborative engagements: (a) student-teacher, (b) student-student, and (c) teacher-teacher as demonstrated by findings articulated in Chapter 8. For example, participants from Museum 9 talked about the Maori concept of 'ako'. This perspective removes the traditionally hierarchical structure of learning. Instead, everyone can be both learner and an expert simultaneously. This finding reaffirms Fullan, Hill, and Rincón-Gallardo' (2017) observation that school district where deep practices are highly embedded, it was normal for students to see their teachers collaborate with their principals, teachers from other grade levels, and even teachers from other schools. One way of encouraging a non-hierarchical relationship in the learning environment is through the physical organisation of the space, such as removal of the 'front' of the room and rigidly arranged rows of tables and chairs. Many of the participating museum educators did not arrange the chairs inside their learning environment into rows nor did most of them have a 'front' of the room. As pointed out by Sommer (1977), the social and physical systems in classrooms are structures entangled.

Findings from this study also concurs with Evan's (1995) conclusion that the physical environment directly and indirectly facilitate or inhibit the formulation and maintenance of social interaction, crucial ingredient in learning. Therefore, the way the museum educators curate their learning environment affects whether students can engage in a social interaction thus affecting their ability to learn. This is critical especially in light of Falk and Dierking's (1992, 2000, 2013) assertion that learning is socially-mediated. Data from this study indicate that in arranging the learning environment in such a way that it removes the traditional learning and modelling collaborative engagements, museum educators demonstrated an openness to working together and learning from each other, which in turn students emulated. Grannäs (2007) found that young people's learning deepens when they try to solve self-defined problems collectively. Additionally, teachers and students can co-curate the learning environment. Not only can students have a say in what might be included but may also contribute elements for the curated learning environment or inform the museum educator's decision in choosing a learning environment.

However, several studies contend that putting students together in groups does not automatically lead to collaboration (Fisher et al., 2002; Tolmie et al., 2009). Educators need to deliberately create opportunities for collaborative learning. An example of this was discussed in Chapter 7 and 8 when museum educators choose technology that required more than one student to use such as the virtual reality headsets in Museum 9 or when museum educators in Museum 5 made a few students share one mBot.

Data from this study indicate that strategies educators can employ to cultivate a collaborative learning environment include encouraging students to combine different ideas (i.e. their ideas and that of their classmates), inciting students to articulate what they have learned/are learning and creating opportunities for different types of collaboration.

Based on data presented in this study, a collaborative learning environment will support the following deep learning competencies:

- Content mastery
- Critical thinking & problem solving
- Collaboration
- Creativity
- Effective communication
- Positive outlook on learning

9.2.3 Continuous: Students' deep learning is supported when educators use the learning environment to encourage continuous learning

The third principle for Curated learning espouses a continuous process of learning, assessment, and improvement for both students and teachers. This principle underscores the iterative and continuous nature of teaching and learning. As Shulman (2004) aptly said, "One never learns to teach once and for all. It is a continuous, ongoing, constantly deepening process" (p. 517).

Some of the participating museum educators in this study showed acceptance humility in articulating that they are not omniscient and that they were open to learning from and with students. This substantiates findings by Matusov and Rogoff (1995) that educators as model learners creates positive 'learning to learn' environments. This openness to continued learning was exemplified in Museum 9 through the participating educators' words and actions in preparing for and while conducting the programs. Their decisions in selecting elements to include in the learning environment and making available materials that allowed students to create multiple versions of their work. They were also very receptive to and quick to act on feedback from their fellow educators on how to improve succeeding sessions. This is consistent with previous studies that showed teachers learning alongside and sometimes even directly from their students and used these opportunities to explore ideas and technology that they were not familiar with (Fullan et al., 2017). Additionally, a teacher learning to use technology with their students disrupts traditional power dynamics in the classroom and opens it up for generation of more ideas and possibilities (Lemon, 2011).

Empirical evidence from this study reveal that strategies educators can use to engender openness to continued learning include demonstrating their personal interest in the topic they were exploring with students, pointing out and correcting students' misconceptions, inciting students to combine different ideas from multiple sources and people, cultivating a positive atmosphere that allowed student to make and learn from their mistakes, and encouraging students to articulate what they have learned/were learning.

As indicated by findings in this study, this principle supports development of the following deep learning competencies:

- Positive outlook on learning
- Content mastery
- Critical thinking & problem solving
- Collaboration
- Creativity
- Effective communication

9.2.4 Creative: Students' deep learning is supported when educators use the learning environment creatively

The fourth principle of Curated learning promotes creative use of elements within the learning environment, delivery of planned lessons, and solutions to spatial issues. Additionally, Curated learning also advocates for creative ways of enabling students to demonstrate learning. In classrooms with limited resources, teachers need to be more creative about using materials that are locally-available (Westbrook, Durrani, Brown, Orr, Pryor, Boddy, & Salvi, 2013).

Findings presented in this study related to this principle aligns with Dennis and O'Hairs' (2010) study who found that a better way for students t to construct knowledge was to make them produce original works (i.e. through writing or creative artworks) instead of giving them multiple choice or matching exams where they only reproduce knowledge gained from memorisation of facts. Several museum educators in this study demonstrated this principle by giving students opportunity to create tapestry, digital artworks, paintings, and videos as discussed in Chapter 7 and 8.

Similar to the Imms and Godinho's (2011) report about a teacher in Tasmania who simulated an imaginary ship in her classroom, some museum educators in this study also demonstrated creative ways of approaching delivery of lessons. For example, as discussed in Chapter 7 and 8, educators from Museum 8 used replicas of military uniform, supplies, and gears to teach about the war. Museum 5 also converted one of their venues to an Australian gold rush town through costumes, props, and audio-visual equipment.

Data from this study confirm that strategies educators can use to promote a creative learning environment includes encouraging students to combine different ideas and deciding to assess students' learning by allowing them to apply knowledge and skills in creating an output.

Based on finding from this study, this principle will assist in developing the following deep learning competencies:

- Content mastery
- Critical thinking & problem solving
- Collaboration
- Creativity
- Citizenship

9.2.5 Combined: Students' deep learning is supported when educators use the learning environment to suit a diversity of pedagogies, strategies, resources, and students' needs

The fifth principle of Curated learning uphold the idea that there is no silver bullet, nor a one size fits all solution to an enriched learning environment. Although there is a perception that deep learning is better than surface learning, in this study, both approaches are valued. Students need both surface and deep knowledge (Hattie, 2009). Student learning approaches exists in a continuum and where the student is situated at a certain point in time depends the context and their learning situation (Postareff, Parpala, & Lindblom- Ylänne, 2015). This current study found that museum educators also engaged students in ways that allowed them to move back and forth between this continuum. Many of the participating museum educators began their program with a discussion to informally assess prior knowledge and interest of students. This assessment allowed museum educators to determine a point from which they can move towards accomplishing their intended learning outcome. This exercise also gave the museum educator a clearer idea on what information students already know and what they needed to provide them with before diving deeper into the topic. This principle disrupts the dichotomous view purporting that surface learning is bad while deep learning is good. Findings from this study support Chow's (2010) contention that students need both to succeed in the new century.

Another dichotomy that Curated learning challenges include the use of physical and digital tools and resources and reaffirms Alexander's (2008) argument against dichotomous pedagogical practice. This finding was consistently apparent across Chapters 6 to 9, where both physical and digital tools heavily featured among the elements used by museum educator for teaching. A study by Lemon (2016) found that digital tools, specifically a digital camera, given to young students for use in classroom activities developed students' communication and problem-solving skills, which they were able to apply in situations outside of the school environment.

Lastly, this principle expands our understanding and openness to accepting a plethora of pedagogies, strategies, resources, and approaches that invite students to engage in minds-on, hands-on, and hearts-on activities in wide variety of learning environments.

Based on empirical evidence presented, strategies that can help educators achieve a 'combined' learning environment are engaging students in active learning through open-ended questions, presenting them with problem solving activities, choosing activities that prompt thoughtful reflection, inciting students to combine different ideas, and creating opportunities for collaboration.

Finding from this study indicate that this principle will assist in developing the following deep learning competencies:

- Critical thinking & problem solving
- Effective communication
- Positive outlook on learning
- Content mastery
- Collaboration
- Creativity

9.2.6 Constructive: Students' deep learning is supported when educators use the learning environment to create an atmosphere that is conducive to the construction of learning

This sixth principle serves as the keystone of Curated learning. The previous five principles applied in concert with this sixth principle results to greater impact on teaching and learning. A constructive learning environment creates conditions that is more conducive to applying the principles discussed above.

For example, several studies contend that putting students together in groups or making them does not automatically lead to collaboration (Fisher et al., 2002; Tolmie et al., 2009). Museum educators had to deliberately create opportunities for collaborative learning not only through their choice and arrangement of furniture but also in allowing students the freedom to explore their learning environment and the agency to decide what tools to use and how to demonstrate their learning.

To encourage continuous learning, museum educators needed to cultivate a positive learning environment where students were encouraged to take risks and mistakes were not seen as failures but as opportunities for learning. This finding is consistent with another study on the nature of learning, which found emotions as integral to learning and that positive beliefs about themselves as learners is a core component for deep understanding and the ability to apply knowledge and skills to different contexts and situations (Dumont, Istance, & Benavides, 2010). Museum educators explicitly (through their selection of activities) and implicitly (in the way they organised elements in the learning environment) incited students to move around the venue, explore resources available to them, and allowed them to pursue preference for completing tasks. This aligns with Evan's assertion that, especially in young children, environmental barriers or social regulations that restrict movement adversely affect learning. The opportunity to explore freely can indirectly affect student's motivation as it is a component of effective interaction with the environment (Evans, 1995). Additionally, findings in this study concurs with a pilot study undertaken by Grainger, Barnes, and Scoffham (2004), which provided evidence that in order to encourage risk taking behaviour of student, it is critical for educators to create a space where students felt safe, valued, and trusted.

Findings discussed in Chapter 8 about creating positive atmosphere also substantiate evidence from previous studies suggesting that students positively favour learning environments that are comfortable and that these kinds of environments support more student-initiated discussions (Sommer & Olsen, 1980).

Data from this study indicate that in creating a constructive learning environment, all 11 strategies identified in Chapter 8 can be applied by educators. These have been enumerated in the beginning of this chapter.

Collectively, findings in this study that support the six principles of Curated learning align with all five principles for designing successful instructions (Merrill, 2002), detailed in Chapter 4. The table below summarise the 6Cs of Curated learning and the different deep learning competencies each principle supports.

Table 9.1

Principles of Curated learning and the corresponding deep learning competencies they support

6Cs of Curated learning	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
Effective communication						
Critical thinking and problem solving						
Positive outlook on learning						
Collaboration						
Content mastery						
Creativity						
Citizenship						

9.3 Factors that influence the use of learning environment to support students' deep learning

As mentioned in Chapter 8, although many of the participants in this study were unfamiliar with the deep learning concept, they unknowingly still used different strategies to support students' deep learning. Additionally, as demonstrated by findings presented in Chapter 8, many of them used elements of the learning environment as part of their deep learning strategies.

Findings from this study suggest two factors that enable or hinder museum educators' use of the learning environment to encourage students' deep learning. I explain these two factors, spatial and organizational, in the following sections.

9.3.1 Spatial factors

Spatial factors refer to the physical attributes of the learning environment such as size, shape, configuration, design, and indoor environmental qualities (IEQ) that affect users of the space. Learning environments that were spatially flexible allowed participants to conduct programs that made use of deep learning strategies such as presenting students with problems to solve, cultivating a positive atmosphere that allowed students to make and learn from their mistakes, creating opportunities for collaboration, providing connections with the real world, and assessing learning through students' ability to demonstrate application of knowledge and skills by creating an output. Participants configured and reconfigured the physical space, selected elements to add or remove to suit their needs, and, to a certain degree, manipulated environmental conditions as they deemed fit.

Participants encouraged the kinds of interaction they wanted between students through their choices of seats, seating furniture, seating arrangement, and location for the program. Their decisions impacted students' ability to participate in individualised, collaborative, or collective learning. This concurs with Alexander's (2008) findings about a school teacher who instructed her six-year-old students to rearrange, sometimes a few times a day, the classroom furniture to suit the class' activity. Museum educators' decisions regarding the physical components of the learning environment fostered students' ability to work individually, collaboratively, and collectively (Alexander, 2008).

Moveable furniture enabled museum educators to re-configure their learning environment for activities that allowed them to use more deep learning strategies. This finding is consistent with Mahat et al.'s (2017) research, where teachers identified moveable furniture and fit-outs as contributing to enhancing students' deep learning.

Additionally, majority of the participating museum educators did not organise students the way students were typically seated in traditional classrooms (i.e. rows of chairs facing the front of the room). Some of the museum educators did not even use chairs or tables and instead filled the learning environment with objects and resources that were accessible to students. Students were given choices on where to sit and what resources to use. Museum educators also did not stay in front of the room and instead actively moved around talking to individuals or groups of students. Removal of this traditional spatial organisation to have encouraged a more open and active engagement between participants and students. Participants were more physically accessible to students. This behaviour aligns with Sommer's (1977) argument that "the physical and the social systems of the classroom are inextricably twined" (p. 175). Changes in the physical structure of the learning environment inevitably impact the social structure within, and vice versa (Sommer, 1977). As pointed out by several museum educators, they considered themselves as facilitators or co-learners in the learning environment, removing the teacher-student hierarchy. This corroborates Kenkmann's (2011) observation that students were more open to expressing their opinions, giving spontaneous responses, and were less concerned about making mistakes when the expert-learner relationship was disrupted. Without this hierarchy, museum educators empowered students to become active agents in their learning (Alexander, 2008) and the learning environment transformed from a traditional classroom into a workshop or a laboratory.

More spatially flexible learning environments also enabled museum educators to embark on a range of activities to support deep learning. In most instances, dialogic discussions were done in front of physical objects and combined with hands-on activities that encouraged the application of skills and trying out new ideas. This is critical because establishing focal points support informal group interactions (Evans, 1995). This has been demonstrated across a multitude of programs in Museum 4, Museum 5 and Museum 9. It is, however, important to note that museum educators moved focal points across different areas of the learning environment. A flexible physical space provides museum educator with a variety of choices for the locations and types of focal points as these were also dependent on the types of activities students were engaged in. Movable and multiple focal points is only possible if the space is flexible enough to accommodate this arrangement.

9.3.2 Organisational factors

Organisational factors refer to culture, politics, leadership embedded within the organisation. Data from this study confirmed that the kinds of elements, variety of spaces, diverse set of tools, and resources for hands-on activities, that museum educators use to assist in enhancing students' deep learning as similar to those identified by school teachers in a previous study by Mahat et al. (2017). Access to these elements, the types of activities museum educators were encouraged to pursue, and their organisation's culture and practices profoundly influenced the agency with which they were able to select and manipulate their learning environment and elements within.

For example, the physical environment, programs, and pedagogy in the Learning laboratory of Museum 9 were designed to be highly conducive in employing deep learning strategies. In choosing the types of furniture and fixtures as well as tools and resources within the learning environment, Museum 9 provided their museum educators more freedom in choosing their approach in delivering the programs. This finding may have implications for school teachers because organisational structures, cultures, and policies have a significant impact on the implementation of deep learning strategies within a school (Mehta & Fine, 2015; Fullan et al., 2017). Fullan et al. (2017) even go as far as to argue that "widespread and rapid transformation of entire school systems" (p. 6) is necessary for schools to successfully engage in deep learning. They further added that in schools that have successfully embedded deep learning as part of their regular practice, teachers and school leaders who were ready to try novel ways of doing things were the ones who initiated the change.

In relation to organisational support, many of the participating museum educators received professional development to help them navigate challenges related to their learning environment. One good example of this was discussed in Chapter 6 where museum educators received training from a theatre performer to enable them to understand how to use their voice, body, features of the different learning venues in the museum. More importantly, they were also trained on how to work with acoustical issues resulting from the architectural design of the museum. Organisational support is critical in preparing educators to not only address issues but also maximise potentials of their learning environments. This supports the study by Saltmarsh et al. (2014) where teachers and principals expressed the need for professional development to assist teachers navigating challenges faced in using non-traditional learning environments. This is important because Lemon and Garvis (2014) found that pre-service teachers' teaching strategies were enriched after visiting an art museum as part of their teacher education course. As discussed in Chapter 4, prior experience, prior knowledge, and prior interests are three factors that may influence how educators use the learning environment for teaching. Therefore, providing professional development and exposing educators to novel ways of using elements of the learning environment have the potential to positively impact their practice.

Findings related to organisational support have implications for schools because as Fullan et al. (2018) asserted that schools have a significant role to play in empowering teachers and providing them with resources to build their capacity. More so for the broader educational system because national examinations, curriculum standards, and other policies significantly impact teacher pedagogy (International Institute for Educational Planning, 2018). Evidence from this study indicate that the way learning is viewed and the culture of museums in general influence and enable museum educators to pursue student-centred teaching approaches. This is consistent with a study which found that teachers in Tanzania were discouraged from shifting to learner-centred pedagogy because of the way that their national exam is designed (Vavrus & Bartlett, 2013). Therefore, for more impactful change to take root, a system-wide reform is required (International Institute for Educational Planning, 2018). This means that teachers' adaptation of principles of Curated learning to support students' deep learning also depends on the milieu within which their practice is situated.

9.4 Summary

In this chapter, I responded to the primary research question by elaborating on the concept of Curated learning through a synthesis of the findings from this study. After examining the theoretical and practical links of Curated learning to museum practice, I continued to expand this concept by articulating the 6Cs of Curated learning. I also established connections between the principles, deep learning strategies, and deep learning competencies. In the next chapter, I will provide an overview of this study, its contributions to research, implications for practice, directions for future research, limitations, and finally, end with some concluding remarks.

CHAPTER 10: CONCLUSION

In this final chapter, supporting museum educators to understand better the positive impact of their spatial practices on student learning and highlight their valuable contributions to both the museum and school sectors.

This chapter includes the conclusion of the research, implications, limitations, and future research. I start by revisiting the overview of the study. I continue with a discussion of how this study contributes to research and its implications to teachers' classroom practice. I also talk about directions for future research and end with some concluding remarks.

10.1 Overview of the study

This study had two main objectives: to investigate strategies museum educators use for maximising features of the learning environment that facilitate students' deep learning and recommend strategies that school teachers can adopt in their classroom practice. I began by laying the ground for discussion of the current study by firstly mapping the museum context, with particular attention to teaching and learning. Subsequently, the broad conceptualizations and literature on affordances and deep learning were deliberated and reviewed.

This was followed by a discussion of the Contextual Model of Learning (Falk & Dierking, 2000), which included three contexts of physical, personal and sociocultural. Viewed from the perspectives of the three contexts, I discussed how this theory was reified in my research.

A qualitative case study approach was chosen for this research as it allowed collection of rich data, which can capture the complexity and detail of the construct under study. A total of 28 participants from nine institutions across Australia and New Zealand participated in the study. This resulted in collection of data from 42 observations and 25 interviews. Triangulation was achieved by informing observations and perspectives of participants with audio recordings of the programs observed, teaching artefacts (worksheets and handouts), and photographs of the learning environment and elements within.

The study produced three major findings, discussed in the next subsection. At its foundation, the findings have provided an understanding of the strategies museum educators use for maximising features of the learning environment that facilitate students' deep learning. Empirical analyses have yielded findings that shed light on the three subsidiary research questions: the physical learning environment where museum educators teach student groups; the elements contained within these learning environments and how they are used; and the strategies museum educators employ that use the elements of the learning environment to encourage students' deep learning. In so doing, it responded to the primary research question: *How do museum educators maximise the use of their learning environment to facilitate students' deep learning?*

10.2 Contributions to research

The overall aim of this research is to investigate strategies museum educators use for maximising features of the learning environment that facilitate students' deep learning. Based on the literature review, the conceptual and analytical frameworks, and empirical analyses of qualitative data, this study has produced contributions to research, captured below.

10.2.1 Extending Falk and Dierking's Contextual Model of Learning

The Contextual Model of Learning (Falk & Dierking, 2000, 2013) has been applied to empirical studies examining learning in a wide range of settings including museums, schools, performing and visual arts, professional and scientific meetings, church, and community. However, prior to this study, it has not been applied to studies that explore teaching in museums. This study has made a contribution by extending Falk and Dierking's (2000, 2013) Contextual Model of Learning in viewing learning from the educators' standpoint and to use it as a framework to investigate how museum educators use the learning environment to support students in developing their own deep learning competencies. The three contexts (physical, personal, and sociocultural) and factors influencing these were reified into elements of the learning environment, pedagogical affordances, and teachers' strategies for supporting students' deep learning.

Reifying Falk & Dierking's framework resulted in an adapted conceptual framework shaped by the data collected and analyses in this study. This new framework, called Learning environment Elements- Affordances-Deep learning Strategies or LEAD, is illustrated in **Figure 10.1**.

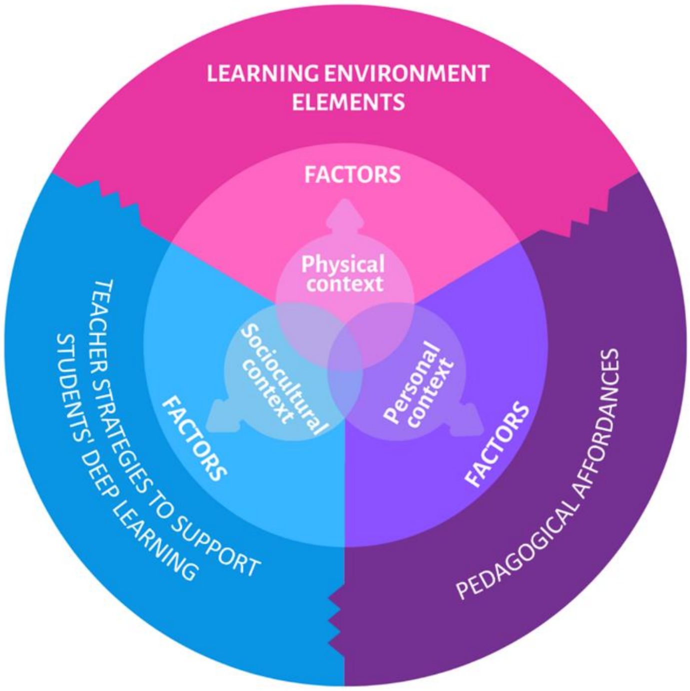


Figure 10.1 LEAD framework adapted from Falk & Dierking's (2000, 2013) Contextual Model of Learning (Villafranca, 2019b)

The findings of this study have shown that a revised framework incorporating elements of the learning environment, pedagogical affordances, and teacher's strategies for students' deep learning provides a more comprehensive view of museum educators practices related to facilitating student learning. By extending the framework, museums can gain a better understanding of the interrelationship between different aspects of the learning environment that influence museum educators' practices.

Additionally, this study also contributed by operationalising the framework into a checklist, discussed in Chapter 5 and included in the appendix, that allows observations of how museum educators used the learning environment in facilitating students' deep learning. Findings in this study support the suitability of the individual items contained under the three broad categories of the observation checklist. The observation checklist can be used by museums to assist museum educators in self-identifying how much of the learning environment they maximise for students' deep learning. While not designed to be an evaluative tool, the observation checklist provides an opportunity for museum educators to reflect on their practice. Since the checklist was also used to observe teaching practices in schools and other non-museum venues, it is viable for use in classrooms and other learning environments.

10.2.2 Curated learning as a pedagogical approach

This study has produced empirical evidence supporting a pedagogical approach, Curated learning, that maximises the use of the learning environment to facilitate students' deep learning. Results of the empirical analyses indicate that through the purposeful selection, manipulation, and use of elements within a learning environment, educators can set-up conditions for students' deep learning. Data from this study also confirms that Curated learning has made more visible the role of the museum educators in setting up conditions that support students in enhancing their deep learning competencies, made more visible the role of the learning environment in enabling museum educators in setting up these conditions, and more visible the kinds of teaching that maximises the learning environment in setting up these conditions.

Based on data from this study, six principles, called 6Cs of Curated learning, have been identified. The principles have been mapped against seven deep learning competencies (New Pedagogies for deep learning: A global Partnership, 2019; William and Flora Hewlett Foundation, 2013) discussed in Chapter 3. These principles will assist educators in using elements within their own learning environments in ways that empower students in developing competencies that will help them succeed in their academic, professional, and civic lives (Chow, 2010; Fullan et al., 2018; William and Flora Hewlett Foundation, 2013).

10.2.3 Pedagogical affordances

This study has also contributed to the understanding of the concept of affordances (Gibson, 1979) by advancing and providing empirical evidence on the existence of pedagogical affordances. Based on data from this study, elements of the learning environment are used by museum educators to support another person's learning. The way these elements are utilised for teaching are called pedagogical affordances, which I define as possible uses of an element of the learning environment to facilitate the learning of another individual.

As discussed in Chapter 2, the theory of affordances has been applied in a variety of ways and in many disciplines (Lindberg, & Lyytinen, 2013). However, application of affordances in the museum field, specifically how it applies to teaching and learning, is limited. This research is perhaps the first to provide evidence of actualised affordances relevant to teaching in museums. To address this gap, I presented a taxonomy of pedagogical affordances illustrated in **Figure 7.15**. The taxonomy is important for two reasons. First, it provides empirical evidence of museum educators' use of pedagogical affordances of elements to support student learning. Second, it offers museum educators choices from a wide range of different elements in inciting different actions and reactions from students.

10.3 Implications for practice

The findings in this study have implications for museum educators' teaching practice. I presented three classifications of learning environment where museum educators taught students and generated a list of elements that museum educators used across different types of museums and in various kinds of student-related activities.

Analysis of empirical data from observations, interviews, audio recordings, photographs, and research journal resulted in three classifications learning environments where museum educators facilitated student learning namely purposely-built teaching areas (such as theatres and classrooms both in schools and museums), public learning places (such as museum galleries and streetspaces in schools), and incidental teaching areas (such as museum lobbies, elevators, hallways, and outdoor spaces).

This study also fills a gap in previous literature about how various elements of the learning environment are utilised by museum educators for facilitating student learning. I had to refer to multiple sources (including literature, reports, and personal experience as a museum educator) to generate for this study's observation checklist a list of elements that museum educators used across different types of museums and in various kinds of student-related activities. The list of elements that museum educators use to facilitate deep learning reported in this study is supported by empirical evidence. The significance of this lies in offering museum educators an opportunity to see what other museum educators are using and, in so doing, help them see other elements that they may not have considered using in the past.

The list of elements also has implications in the school context because as Newton (2009) pointed out, educators are not generally trained to perceive the relationship between the learning environment and effective teaching. As pointed out earlier, the types of elements used by museum educators reported in this study may also be found inside school classrooms (See for examples: Ahmed et al., 2004; González-Vera & Hornero Corisco, 2016; Tondeur et al., 2017). Therefore, school teachers may also refer to this list in exploring other types of elements that they may not have considered using in their classrooms.

This study also found that aside from those identified in the Contextual Model of Learning (Falk & Dierking, 2000, 2013), there are other factors that inform museum educators' use of the learning environments. These factors include their agency to curate the learning environment, their spatial competency to understand and effectively use the learning environment, and the organisational culture as an enabler to build agency and competency.

10.4 Implications for theory

The Contextual Model of Learning (Falk & Dierking, 2000, 2013) provided a solid empirical and contemporary structure for investigating how museum educators utilised the learning environment to support students' deep learning.

As a descriptive framework, the Contextual Model of Learning (Falk & Dierking, 2000, 2013) provided a way to organise and analyse data and report findings on strategies employed by museum educators on using the learning environment to facilitate students' deep learning. Although the Contextual Model of Learning (Falk & Dierking, 2000, 2013) is a framework originally developed for understanding visitor learning in museums, empirical evidence presented in this study prove that it is a viable conceptual framework for examining museum educators' practice. Additionally, the framework provided a structure to empirically identify the relationships between interconnected contexts that influenced museum educators' practice.

Using the case study approach and applying the Contextual Model of Learning (Falk & Dierking, 2000, 2013) to investigate museum educator practices has theoretical implications because as Lee Shulman (1983) stated, "One major virtue of a case study is its ability to evoke images of the possible… It is often the goal of policy to pursue the possible, not only to support the probable or frequent. The well-crafted case instantiates the possible, not only documenting that it can be done, but also laying out at least one detailed example of how it is organized, developed, and pursued" (p. 495).

10.5 Directions for future research

This research has produced contributions to research by extending Falk and Dierking's (2000, 2013) Contextual Model of Learning, proposing Curated learning as a pedagogical approach for maximising the learning environment for students' deep learning, and presenting a taxomony of pedagogical affordances. Reifying the Contextual Model of Learning (Falk & Dierking, 2000, 2013) resulted in an adapted conceptual framework called Learning environment Elements-Affordances-Deep learning Strategies or LEAD. Further validation is necessary to confirm that this framework could be applied to investigating the interrelationship between different aspects of the learning environment that influence museum educators' practices. Further studies are also necessary to confirm that principles of Curated learning, when applied by educators, results to improvement in students' deep learning. Such studies will require involving students as participants.

Due to the scale of this study, it did not set-out to, nor could it have accounted for the possibly infinite ways in which elements of the learning environment may be used for teaching. Different factors influence perception and use of affordances (Gibson, 1979, 1982; Norman, 2013) and that these are context specific (Heft, 1989). Therefore, the taxonomy of pedagogical affordances is just a starting point and there is a need to pursue further studies centred on how museums, in general, and museum educators in particular, use the learning environment in supporting students' deep learning. The museum setting after all is a fertile ground for studying the relationships between the physical environment and learning, and yet, this is mostly neglected (Evans, 1995).

Data from this study indicate that most of the museum educators who participated in this study demonstrate the ability to curate their learning environment to suit intended pedagogy and influence learning outcomes. Although my study did not formally collect information pertaining to participants' educational background and professional engagements outside of their role as museum educators, during conversations with participants, some of these background information came to light. Hence, I know that some participants were trained as school teachers while others hold part-time school teacher roles. It would be valuable to investigate whether museum educators who are also school teachers practice Curated learning when they switch into their school teacher role. My instinct and personal experience as a museum educator tells me that exposure to the organisational culture and practices in museums cultivates this ability and makes curating the environment almost second nature for some museum professionals. Understanding whether this is true may have implications for teachers' professional development and in equipping them with the competencies necessary to maximise their learning environment for students' learning.

Additionally, the third case study intended to find out what and how school teachers used elements of museum galleries or museum classrooms to facilitate their own students' deep learning did not materialise. A highly detailed description for the third case study was included in Chapter 5 to demonstrate that there is a major gap that requires further investigation in future studies.

10.5 Final thoughts

In Chapter 1, I discussed how this research fits within and contributes to the Australian Research Council (ARC) Linkage Project called Innovative Learning Environments and Teacher Change (ILETC) that investigates how school teachers across Australia and New Zealand can utilise innovative learning environments (ILEs) to improve pedagogy that leads to students' deep learning. My research focused on another type of learning institution, museums, that seem to be successful at utilising the environment to positively affect student learning. My study has contributed to the ILECT project by bringing in the perspective of museum educators in helping school teachers understand how they might use the learning environment to support students' deep learning. In conducting this research, I also developed tools and strategies that may be useful for school teachers in innovative learning environments.

On a more personal level, pursuing this research has provided me with the opportunity to reflect on my practice as a museum educator. I originally set out to understand why my experience learning about art and heritage was different from my other schooling experience. Not only did I gain insights on what is different in the way museum educators teach but I also realised that my own practice as a museum educator is not lagging behind that of other practitioners. This is despite spending much of my professional career in a developing country that is still trying to catch up on innovations in the museum field. This, for me, is great news towards decolonising[14] museums.

I periodically share updates with participants who have consented to receive future developments about my research. I wish to end this thesis with an excerpt from an email I received from one of the participants of the study. To

[14] To decolonise refers to "a process that institutions undergo to expand the perspective they portray beyond those of the dominant cultural group, particularly white colonizers". (Hatzipanagos, 2018)

protect her anonymity, I removed identifying information from her message. Words that have been removed and replaced are enclosed in brackets.

> *It's terrific to receive your email at this time because in the recent two weeks I have mentioned the influence of your research on our practices to both new [learning program] presenters, who have started with our team in the last few months, and as recently as yesterday to a teacher who was on excursion at [Museum]. The teacher brought her Year 4 cohort to undertake the combined [Program 1] and [Program 2] programs, and because she has undertaken these programs since 2014, she commented about our new program location and resource format for the discussion-based [Program 2] program. The teacher's feedback that she wrote on our evaluation form is as follow:*
>
> *What aspects of the program worked particularly well?*
>
> *[Program] role play/observing historical objects. Keeping the objects in boxes built anticipation and curiosity for the students - they were excited! Working in small groups created more discussion (than the original configuration with the objects laid out in a circle). Thank you for another great excursion!*

In the beginning of this thesis, I wrote that this research is not just about investigating strategies of museum educators to help students learn better but about finding teaching strategies of museum educators that school teachers may employ so that their students will enjoy learning. I think this message from one of the participants indicates promising influence of Curated learning to museum educator and teacher practices.

REFERENCES

Abdal-Haqq, I. (1998). *Constructivism in teacher education: Considerations for those who would link practice to theory*. Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education.

Achiam, M. (2015). *The selective uptake of ideas about out-of-school science education*. Paper presented at the Annual Conference of the European Network for Science Centres and Museums, Trento, Italy.

Achiam, M., May, M., & Marandino, M. (2014). Affordances and distributed cognition in museum exhibitions. *Museum Management & Curatorship, 29*(5), 461-481.

Ahmed, A., Clark-jeavons, A., & Oldknow, A. (2004). How can teaching aids improve the quality of mathematics education. *Educational Studies in Mathematics, 56*(2), 313-328. doi:10.1023/B:EDUC.0000040412.39121.e0

Allard, M., Boucher, S., & Forest, L. (1994). The museum and the school. *McGill Journal of Education, 29*(2), 197-212.

Alexander, E. P., & Alexander, M. (2008). *Museums in motion: An introduction to the history and functions of museums*. Lanham: AltaMira Press.

Alexander, R. (2008). *Essays on Pedagogy.* London: Routledge.

Alismail, H., & McGuire, P. (2015). 21st century standards and curriculum: Current Research and Practice. *Journal of Education and Practice, 6*(6), 150-155.

Alterator, S., & Deed, C. (2016). Reacting to “Irregular” learning environments in a senior secondary school. *Curriculum and Teaching*, *31*(2), 47–69. doi:10.7459/ct/31.2.04

Ambrose, T., & Paine, C. (2012). *Museum basics*. Abingdon, Oxon; New York: Routledge.

Andreas M, R. (2003). Validity and reliability tests in case study research: A literature review with "hands-on" applications for each research phase. *Qualitative Market Research: An International Journal*, *6*(2), 75-86.

Asian Cultural Council. (n.d.). *Our history.* Retrieved from https://www.asianculturalcouncil.org/about-us/our-history

Australian Bureau of Statistics. (2009). *Museums, Australia 2007-8. (Catalogue No. 8560.0).* Retrieved from http://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/8560.0Main%20Features22007-

08?opendocument&tabname=Summary&prodno=8560.0&issue=2007-08&num=&view=

Australian Government. (2014). *Convicts and the British Colonies in Australia.* Retrieved from https://web.archive.org/web/20160101181100/http://www.australia.gov.au/about-australia/australian-story/convicts-and-the-british-colonies

Bailey, K. D. (1994). *Typologies and taxonomies: An introduction to classification techniques.* Thousand Oaks, CA: Sage.

Bamberger, Y., & Tal, T. J. (2008). Multiple outcomes of class visits to natural history museums: The students' view. *Journal of Science Education and Technology, 17*(3), 274-284. doi:10.1007/s10956-008-9097-3

Batelle for Kids. (2019). Framework for 21st century learning definitions. Retrieved from http://www.battelleforkids.org/networks/p21/frameworks-resources

Barad, K. (2007). *Meeting the university halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), 544.

Beattie, V., Collins, B., & Mcinnes, B. (1997). Deep and surface learning: A simple or simplistic dichotomy? *Accounting Education*, 6(1), 1-12.

Bedford, L. (2014). *The art of museum exhibitions: How story and imagination create aesthetic experiences*. Walnut Creek, California: Left Coast Press, Inc.

Biernacki, P., & Waldorf, D. (1981). Snowball sampling: Problems and techniques of chain referral sampling. Sociological Methods and Research, 10(2), 141–163.

Bell, D. (2010). A great day out: Making the best of your museum visit. *Scope: Contemporary Research Topics (Art & Design)*, *5*(6), 160-169.

Bell, D. R. (2017). Aesthetic encounters and learning in the museum. *Educational Philosophy and Theory, 49*, 776-778. doi:10.1080/00131857.2016.1214899

Biggs, J. B. (1970). Faculty patterns in study behaviour. *Australian Journal of Psychology, 22*(2), 161-174. doi:10.1080/00049537008254570

Biggs, J. B. (1978). Individual and group differences in study processes. *British Journal of Educational Psychology, 48*(3), 266-279.

Biggs, J. B. (1987a). *Study Process Questionnaire manual. Student approaches to learning and studying.* Hawthorn: Australian Council for Educational Research.

Biggs, J. B. (1987b). *Student approaches to studying and learning. Research monograph.* Hawthorn: Australian Council for Educational Research.

Biggs, J. B., & Tang, C. S. (2011). *Teaching for quality learning at university: What the student does*. Maidenhead, Berkshire: Open University Press.

Blackmore, J., Bateman, D., O'Mara, J., Loughlin, J., & Aranda, G. (2011). The connections between learning spaces and learning outcomes: People and learning places? Retrieved from http://www.learningspaces.edu.au/docs/learningspaces-literature-review.pdf

Bobick, B. (2012). Museum Education Experiences from University Pre-Service Art Education Students in an Urban Art Museum. *National Teacher Education Journal, 5*(1), 19–27.

Boston, P. & Zhao, B. (2017). Failing to innovate. Ivey Business Journal. Retrieved from https://iveybusinessjournal.com/failing-to-innovate/

Boys, J., Boddington,A., & Speight, C. (2013). *Museums and higher education working together: Challenges and opportunities.* Surrey, UK: Ashgate Publishing Limited.

Brice-Heath, S. (1981). Toward an ethnohistory of writing in American education. In M.F. Whiteman (Ed.), *Writing: The nature, development and teaching of written communication* (pp. 25-45) (Vol. 1). Hillsdale, NJ: Erlbaum.

Brice-Heath, S. (1983). *Ways with words: Language, life and work in communities and classrooms*. Cambridge, UK: Cambridge University Press.

Brooks, J. G., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, Va., USA: Association for Supervision and Curriculum Development.

Cassidy, S. (2016, March 12). Schools move lessons to local museums for learning experiment. *The Independent.* Retrieved from http://www.independent.co.uk/news/education/education-news/schools-move-lessons-to-local-museums-for-learning-experiment-a6926291.html

Caulley, D. (1994). Qualitative methodology: Qualitative data analysis in program evaluation. *Evaluation News and Comment*, *3*(2), 68–73.

Chandler, R., Antsey, E. H., Munro, C. L., & Morrison-Beedy, D. (2013). Experiencing Audio Recorded Research (EARR): Giving Voice to Qualitative

Poster Presentations. *The Qualitative Report*, *18*(43), 1-9. Retrieved from https://nsuworks.nova.edu/tqr/vol18/iss43/3

Charitonos, K. (2015). *An investigation into the use of a microblogging technology in school trips to museums* (Doctoral thesis, The Open University). Retrieved from http://oro.open.ac.uk/44866/

Chow, B. (2010, October 5). The quest for deep learning. *Education Week.* Retrieved from https://www.edweek.org/ew/articles/2010/10/06/06chow_ep.h30.html

Cleveland, B. (2009). Engaging spaces: An investigation into middle school educational opportunities provided by innovative built environments: A nnew approach to undertanding the relationship between learning and space: *The International Journal of Learning, 16*(5), 385-397.

Coe, J. (1985). Design and Perception: Making the Zoo Experience Real. *Zoo Biology, 4,* 197–208

Conole, G., & Dyke, M. (2004). What are the affordances of information and communication technologies? *Alt-J*, *12*(2), 113–124.

Cotterell, J. L. (1984). Effects of school architectural design on student and teacher anxiety. *Environment & Behavior*, 16(4), 455–479.

Council of Australasian Museum Directors. (2015, July 15, 2015). *Education.* Retrieved from https://camd.org.au/showcasing-museums/education/

Crabtree, B. F., & Miller, W. L. (Eds.). (1992). *Doing qualitative research*. California: Sage Publications

Cramer, E.P., McLeod D.A., Craft, M, & Agnelli K. (2018). Using arts-based materials to explore complexities of clinical decision-making in a social work methods course. *Social Work Education, 37*(3), 342-360. doi:10.1080/02615479.2017.1401061

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches.* California: Sage Publications.

D'Adderio, L. (2008). The performativity of routines: Theorising the influence of Artefacts and distributed agencies on routines dynamics. *Research Policy*, *37*(5), 769–789.

Dane, J. (2016). Effective teaching and learning spatial framework: An evaluation tool. In W. Imms, B. Cleveland & K. Fisher (Eds.), *Evaluating Learning Environments: Snapshots of Emerging Issues, Methods and Knowledge* (pp. 211-228). Rotterdam, Netherlands: Sense Publishers.

Davis, J., Leach, B., & Michaelson, M. (1996). *The MUSE book: a report on the work of project MUSE*. Cambridge, Mass: Harvard Graduate School of Education. Project Zero.

Del Gaudio, I. (2015). *Learning in museums and young people.* Germany: Network of European Museum Organisations.

Dennis, J., & O'hair, M. J. (2010). Overcoming obstacles in using authentic instruction: A comparative case study of high school math & science teachers. *American Secondary Education, 2*(10), 4-22.

Denzin, N. K. (2009). *The research act: A theoretical introduction to sociological methods.* New York, NY: Aldine Transaction.

Department of Education, Emplyment, and Workplace Relations. (2010). Building the Education Revolution. Retrieved from https://web.archive.org/web/20100417041604/http://www.deewr.gov.au/schooling/buildingtheeducationrevolution/Pages/default.aspx

Dewey, J. (1938). *Logic, the theory of inquiry*. New York: Holt.

Dibley, L. (2011). *Analyzing narrative data using McCormack's lenses. Nurse Researcher, 18*(3), 13-19.

Dewey, J. (2009). *The school and society and the child and the curriculum.* US: BN Publishing. (Original work published 1902).

Dierking, L. (2002). The role of context in children's learning from objects and experiences. In S. Paris (Ed.), *Perspective in object centered learning in museums* (pp. 3-18). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Dörnyei, Z. (2007). *Research methods in applied linguistics*. New York: Oxford University Press.

Dovey, K., & Fisher, K. (2014). Designing for adaptation: the school as socio-spatial assemblage. *The Journal of Architecture, 19*(1), 43-63.

Downey, S., Delamatre, J., & Jones, J. (2007). Measuring the impact of museum-school programs: Findings and implications for practice. *Journal of Museum Education, 32*(2*)*, 175-187. doi:10.1080/10598650.2007.11510567

Dumont, H., Istance, D., & Benavides. (2010). *The nature of learning: Using research to inspire practice*. Paris: OECD, Centre for Educational Research and Innovation. Retrieved from http://www.oecd.org/education/ceri/50300814.pdf

Dunlop, L., Clarke L., & McKelvey-Martin, V. (2019) Free-choice learning in school science: a model for collaboration between formal and informal science educators. *International Journal of Science Education, Part B*, 9(1), 13-28, doi:10.1080/21548455.2018.1534023

Eckes, A., Groβmann, N., & Wilde, M. (2018). Studies on the effects of structure in the context of autonomy-supportive or controlling teacher behavior on students' intrinsic motivation. *Learning and Individual Differences, 62,* 69–78.

Education Writers Association, & William and Flora Hewlett Foundation. (2017). *Decoding Deeper Learning in the Classroom.* Education Writers Association. Education Writers Association. Retrieved from https://hewlett.org/decoding-deeper-learning-in-the-classroom/

Elliott, A., & Hearst, M. (2002). A comparison of the affordances of a digital desk and tablet for architectural image tasks. *International Journal of Human-Computer Studies, 56*(2), 173–197.

Ellis, J., & Strong-Wilson, T. (2007). Children and place: Reggio Emilia's environment as third teacher. *Theory into Practice*, 46*(1)*, 40-47.

Encyclopaedia Brittanica. (2018) Ramayana. Retrieved from https://www.britannica.com/topic/Ramayana-Indian-epic

Entwistle, N. (1988). *Styles of Learning and Teaching.* London: David Fulton.

Entwistle, N. (2001). Styles of learning and approaches to studying in higher education. *Kybernetes, 30*(5-6), 593-603. https://doi.org/10.1108/03684920110391823

Evans, G.W. (1995). Learning and the Physical Environment. In J.H. Falk L. D. Dierking (Eds.), *Public Institutions for Personal Learning* (pp. 119-126). Washington, D.C.: American Association of Museums.

Falk, J. H. (1983). Time and behavior as predictors of learning. Science Education, 67, 267–276. doi:10.1002/sce.3730670214.

Falk, J. H. (1997a). Recent advances in the neurosciences: Implications for visitor studies. In M. Wells & R. Loomis (Eds.), *Visitor studies: Theory, research and practice Vol. 9* (pp. 227–238). Jacksonville, AL: Visitor Studies Association.

Falk, J. H. (1997b). Testing a museum exhibition design assumption: Effect of explicit labeling of exhibit clusters on visitor concept development. *Science Education, 81,* 679‑687.

Falk, J. H., & Balling, J. D. (1982). The field trip milieu: Learning and behavior as a function of contextual events. *Journal of Educational Research, 76*, 22–28.

Falk, J. H., & Dierking, L. D. (1992). *The museum experience*. Washington DC: Whalesback Books.

Falk, J. H., & Dierking, L. D. (1995). Recalling the museum experience. *The Journal of Museum Education*, 20(2), 10-13.

Falk, J. H., & Dierking, L. D. (2008). Enhancing Visitor Interaction and Learning with Mobile Technologies. In L. Tallon (Ed.), *Digital technologies and the museum experience: Handheld guides and other media* (p. 19-33). Walnut Creek, CA: AltaMira Press.

Falk, J. H., & Dierking, L. D. (2000). *Learning from museums: Visitor experiences and the making of meaning*. Walnut Creek, CA: AltaMira Press.

Falk, J. H., & Dierking, L. D. (1997). School field trips: Assessing their long-term impact. *Curator*, *40*(3), 211-218.

Falk, J. H., & Dierking, L. D. (2013). *The museum experience revisited*. Walnut Creek, California: Left Coast Press.

Falk, J. H., Dierking, L. D., & Holland, D. G. (1995). What do we think people learn in museums? In J. Falk & L. Dierking (Eds.), *Public institutions for personal learning: Establishing a research agenda (pp*. 17-22). Washington DC: American Association of Museums.

Falk, J. H., Koran, J. J, Jr., & Dierking, L. D. (1986). The things of science: Assessing the learning potential of science museums. *Science Education, 70*, 503–508. doi:10.1002/sce.3730700504.

Falk, J. H., Koran, J. J, Jr., Dierking, L. D., & Dreblow, L. (1985). Predicting visitor behavior. *Curator, 28*, 326–332. doi:10.1111/j.2151-6952.1985.tb01753.x.

Fisher, M. (1997). The effect of humor on learning in a planetarium. *Science Education, 81*, 703–713.

Fields, D. A., & Kafai, Y. B. (2009). *A connective ethnography of peer knowledge sharing and diffusion in a tween virtual world. Computer Supported Collaborative Learning, 4*(1), 47-69. doi:10.1007/s11412-008-9057-1

Grannäs, J. (2007). Peer engagement in Learning Democracy. *International Journal of Learning, 14*(8), 189-196.

Koran, J. J, Jr., & Dierking-Shafer, L. (1982). Learning science in informal settings outside the classroom. In M. B. Rowe (Ed.), *Science in the 80's* (pp. 52–62). Washington, DC: National Education Association.

Koran, J. J, Jr., Longino, S. J., & Shafer, L. D. (1983). A framework for conceptualizing research in natural history museums and science centers.

Journal of Research in Science Teaching, 20, 325–339. doi:10.1002/tea.3660200407.

Falk, J. H., & Storksdieck, M. (2005). Using the contextual model of learning to understand visitor learning from a science centre exhibition. *Science Education, 89*, 744–778.

Fayard, A., & Weeks, J. (2007). Photocopiers and water-coolers: The affordances of informal interaction. *Organization Studies, 28*(5), 605–634.

Fitzpatrick, G. S., & Angus, M. J. (1975). *Through Teachers' Eyes: Teaching in an Open Space Primary School* (Technical Report No. 1). Canberra: Australian Advisory Committee of Research and Development in Education.

Flyvbjerg, B. (2004). Five misunderstandings about case-study research. In C. Seale, G. Gobo, J. F. Gubrium, & D. Silverman (Eds.), *Qualitative Research Practice* (Vol. 2, pp. 420–434). London and Thousand Oaks: Sage.

Ford, Angela. (2016). Planning classroom design and layout to increase pedagogical options for secondary teachers. *Educational Planning, 23*(1), 25-33.

Frelin, A., & Grannäs, J. (2010). Negotiations left behind: In-between spaces of teacher–student negotiation and their significance for education. *Journal of Curriculum Studies, 42*(3), 353-369.

Frelin, A., & Grannäs, J. (2019, March). *Teachers' pedagogical conceptions of a planned activity based learning environment.* Paper presented at the Nordic Educational Research Association, Uppsala, Sweden. Abstract retrieved from https://www.nera2019.com/wp-content/uploads/sites/36/2019/03/abstract-book-nera-2019-03-06.pdf

Fullan, M., & Langworthy, M. (2014). *A rich seam: How new pedagogies find deep learning*. London: Pearson. Retrieved from https://www.michaelfullan.ca/wp-content/uploads/2014/01/3897.Rich_Seam_web.pdf

Fullan, M., Quinn, J., & McEachen, J. (2018). *Deep Learning: Engage the world change the world.* Thousand Oaks, California: Corwin.

Fullan, M., Hill, P., & Rincón-Gallardo, S. (2017). Deep Learning: Shaking the Foundation. Ontario: Canada: Retrieved from https://www.npdl.global/wp-content/uploads/2017/07/DL-shaking-the-foundation.pdf

Gardner, H. (1985). *Frames of mind: The theory of multiple intelligences*. London: Paladin.

Gaver, W. (1991). Technology Affordances. In S. Robertson, G. Olson, & J. Olson (Eds.), *Proceeding of the SIGCHI conference on Human factors in computing systems* (pp. 79–84). doi:10.1145/108844.108856

Gaver, W. (1996). Situating action II: Affordances for interaction: The social is material for design. *Ecological Psychology, 8*(2), 111–129.

Gehrke, N. J., & et al. (1982). *An analysis of teachers' perceptions of their school environment*. Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education, 17-20 February 1982, Houston, Texas.

Getting Smart. (2013). Infographic: Deeper Learning. Retrieved from https://www.gettingsmart.com/2013/10/schools-highlighted-deeper-learning-infographic/#

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Giddens, A. (1984). *The constitution of society: Outline of the theory of structure.* Berkeley, CA: University of California Press.

Gillespie, C. W. (2000). Six head start classrooms begin to explore the Reggio Emilia approach. *Young Children, 55*(1), 21-27.

Godinho, S., & Imms, W. (2011). Voyage of the SS Discovery, and The Truman Show: Case studies of integrative approaches to bridging the disciplinary divides. *Curriculum and teaching, 26*, 87-107.

Golightly, A., & Raath, S. (2015). Problem-Based Learning to Foster Deep Learning in Preservice Geography Teacher Education. *Journal of Geography*, *114*(2), 58-68.

González-Vera, P., & Horner Corisco, A. (2016). Audiovisual materials: A way to reinforce listening skills in primary school teacher education. *Language Value, 1*(8), 1-25. doi:10.6035/LanguageV.2016.8.2

Grainger, T., Barnes, J., & Scoffham, S. (2004) A creative cocktail: Creative teaching in initial teacher education. *Journal of Education for Teaching,* 30(3), 243-253. doi:10.1080/0260747042000309475

Greasley, K., & Ashworth, P. (2007). The Phenomenology of 'Approach to Studying': The university student's studies within the lifeworld. *British Educational Research Journal,* 6, 819-843.

Greeno, J. G. (1994). Gibson's affordances. *Psychological Review*, *101*(2), 336-342.

Griffin, J. (2011). The museum education mix: Students, teachers and museum educators. In D. Griffin & L. Paroissien (Eds.), *Understanding museums: Australian museums and museology.* Retrieved from http://nma.gov.au/research/understanding-museums/_lib/pdf/Understanding-Museums_Education_visitors.pdf

Groundwater-Smith, S., & Kelly, L. (2003). *As we see it: Improving learning in the museum.* Paper presented at the British Educational Research Association Annual Conference, Heriot-Watt University, Edinburgh.

Guerriero, S. (2017). *Pedagogical knowledge and the changing nature of the teaching profession.* Paris: OECD.

Halpern, D. (2007). The nature and nurture of critical thinking. In R. Sternberg, H. Roediger, & D. Halpern (Eds.). *Critical thinking in Psychology* (pp. 1-14). New York, USA: Cambridge University Press.

Hammond, M. (2010). What is an affordance and can it help us understand the use of ICT in education? *Education and Information Technologies, 15*(3), 205–217.

Hannan, L., Duhs, R., & Chatterjee, H. (2013). Object-based learning: A powerful pedagogy for higher education. In A. Boddington, J. Boys, & C. Speight (Eds.), *Museums and higher education working together: Challenges and opportunities* (pp. 159-168). Surrey, UK: Ashgate Publishing Limited.

Hattaway Communications. (March 20, 2018). T*eacher insights for increasing deeper learning adoption in schools* [Memorandum]. Washington, DC: Author. Retrieved from https://hewlett.org/wp-content/uploads/2018/07/UPDATED-Teacher-Insights-for-Increasing-Deeper-Learning-Adoption-in-Schools_Hattaway-Communications-Memo.pdf

Hattaway Communications. (2017). *Deeper learning audience research insights.* Retrieved from https://hewlett.org/wp-content/uploads/2018/07/Deeper_Learning_Audience_Research_Insights.pdf

Hattie, J. (2003). *Teachers make a difference: What is the research evidence?* Paper presented at the Australian Council for Educational Research Annual Conference on Building Teacher Quality, Melbourne.

Hattie, J. (2009). *Visible learning: a synthesis of over 800 meta-analyses relating to achievement*. London; New York: Routledge.

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning.* New York: Routledge.

Hattie, J. (2015). Opening address. In *Terrains 2015 Mapping learning environment evaluation across the design and education landscape: Towards the evidence-based design of education facilities* (pp. 10-11). Melbourne, Australia: LEaRN.

Hattie, J., & Clinton, J. M. (2011). School leaders as evaluators. In *Activate: A leader's guide to people, practices and processes* (pp. 93–118). Englewood, CO: The Leadership and Learning Centre.

Hatzipanagos, R. (2018, October 12). The 'decolonization' of the American museum. *The Washington Post.* Retrieved from https://www.washingtonpost.com/nation/2018/10/12/decolonization-american-museum/

Healy, S., Grant, G., Villafranca, E., & Yang, P. (2015). *A theoretical orientation for evaluating the geographies of new generation learning environments:* Proceedings of the Second Annual International Learning Environments Research Higher Degree Symposium (pp. 13-20). Victoria, Australia: The Learning Environments Applied Research Network.

Heft, H. (1989). Affordances and the body: An intentional analysis of Gibson's ecological approach to visual perception. *Journal for the Theory of Social Behaivior, 19*(1), 1-30.

Hein, G. E. (1998). *Learning in the museum.* New York, NY: Routledge.

Hein, G. E., & Alexander, M. (1998). *Museums, places of learning*. Washington, DC: American Association of Museums Education Committee.

Herriott, R.E., & Firestone, W.A. (1983). Multisite qualitative policy research: Optimizing description and generalizability. *Educational Researcher, 12*(2), 14-19.

Heyman, M. (1978). *Places and spaces: Environmental psychology in Education. Fastback 112*. Bloomington, IN: Phi Delta Kappa Educational Foundation.

Higgins, S., Hall, E., Wall, K., Woolner, P., & McCaughey, C. (2005). *The Impact of school environments: A literature review*. London: Design Council. Retrieved from www.designcouncil.org.uk/resources/assets/assets/pdf/Publications/The%20Impact%

Hirzy, E. C. (1996). *True needs, true partners: Museums and schools transforming education*. Washington, DC: Institute of Museum Services.

Holliday, G., Lederman, J., & Lederman, N. (2014). "Wow! look at that!": Discourse as a means to improve teachers' science content learning in informal science institutions. *Journal of Science Teacher Education, 25*, 935-952. doi: 10.1007/s10972-014-9409-9

Hooper-Greenhill, E. (1987). Museums in education towards the end of the century. In T. Ambrose (Ed.), *Education in museums: Museums in education* (pp. 39-51). Edinburgh: Scottish Museum Council.

Hooper-Greenhill, E. (1991). *Museum and gallery education*. Leicester: Leicester University Press.

Hooper-Greenhill, E. (1992). *Museum and the Shaping of Knowledge.* New York: Routledge.

Hooper-Greenhill, E., Dodd, J., Gibson, L., Phillips, M., Jones, C., & Sullivan, E. (2006). *What did you learn at the museum today? Second study: evaluation of the outcome and impact of learning through implementation of Education Programme Delivery Plans across nine Regional Hubs (2005)*. Leicester, UK: Research Centre for Museums and Galleries. Retrieved from https://le.ac.uk/rcmg/research-archive/what-did-you-learn-2

Hou, H.-T., Wu, S.-Y., Lin, P.-C., Sung, Y.-T., Lin, J.-W., & Chang, K.-E. (2014). A blended mobile learning environment for museum learning. *Educational Technology & Society*, *17* (2), 207–218.

Houghton, W. (2004). *Engineering subject centre guide: learning and teaching theory for engineering academics*. Loughborough: Higher Education Academy Engineering Subject Centre, Loughborough University.

Howe, M. J. A. (1984). *A Teachers' Guide to the Psychology of Learning*. Oxford: Blackwell.

Hsu, T., & Liang, H. (2017). A cyclical learning model to promote children's online and on-site museum learning. *The Electronic Library, 35*(2), 333-347. doi: 10.1108/EL-01-2016-0021

Hsu, T., Liang, H., Chiou, C., & Tseng, J. (2018). CoboChild: A blended mobile game-based learning service for children in museum contexts. *Data Technologies and Applications, 52*(3), 294-312.

Hubard, O. (2015). *Arts museum education: Facilitating gallery experience.* New York: Palgrave Macmillan.

Huberman, M., Bitter, C., Anthony, J., & O'Day, J. (2014). *The shape of deeper learning: Strategies, structures, and cultures in deeper learning network high schools. Findings from the Study of Deeper Learning Opportunities and Outcomes* (Report 1). Washington, DC, and New York, NY: American Institutes for Research and the Research Alliance for New York City Schools.

Huberman, M., Duffy, H., Mason, J., Zeiser, K., & O'Day, J. (2016). *School features and student opportunities for deeper learning. Findings from the study of deeper learning opportunities and outcomes* (Report 5). Washington, DC, and New York, NY: American Institutes for Research and the Research Alliance for New York City Schools.

Hutchby, I. (2001). Technologies, texts and affordances. *Sociology*, *35*(2), 441–456.

Hutchby, I. (2003). Affordances and the analysis of technologically mediated interaction: A response to Brian Rappert. *Sociology*, *37*(3), 581–589.

Hurworthy, R. (1996). Qualitative methodology: Some questions and answers about analysis of qualitative data in evaluation. *Evaluation News and Comment*, *5*(2), 63–64.

Imms, W., Mahat, M., Byers, T., & Murphy, D. (2017). *Type and use of innovative learning environments in Australasian schools* ILETC Survey No. 1. Melbourne: University of Melbourne, LEaRN, Retrieved from: http://www.iletc.com.au/publications/reports.

Inan, H. Z., Trundle, K. C., & Kantor, R. (2010). Understanding natural sciences education in a Reggio Emilia-Inspired preschool. *Journal of Research in Science Teaching, 47*(10), 1186-1208.

International Council of Museums. (n.d.). *Museum definition.* Retrieved from http://icom.museum/the-vision/museum-definition/

International Institute for Educational Planning. (2018, March). *Effective and appropriate pedagogy* (Brief 3). Paris, France: Author. Retrieved from https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/teachers-and-pedagogy/effective-and-appropriate-pedagogy

Johnson, A. (2009). Museum education and museum educators. In Johnson, A., Huber, K., Cutler, N., Bingham M., & Grove, T. (eds.), *The Museum educator manual: Educators share successful techniques* (pp. 7-14). Lanham, MD: Altamira Press.

Kay, K., & Greenhill, V. (2017). Twenty-first century students Need 21st Century skills. In Wan, G., & Gut, D. (Eds.), *Bringing Schools into the 21st Century* (pp. 41-65). New York: Springer.

Kenkmann, A. (2011). Power and authenticity: Moving from the classroom to the museum. *Adult Education Quarterly, 61*(3), 279-295.

Kerlinger, F. N. (1986). Foundations of Behavioral Research (Third). Japan: CBS Publishing Limited.

Kervin, L., Vialle, W., Herrington, J., & Okely, T. (2006). *Research for educators*. South Melbourne: Thomson Learning Australia.

Ketchum, W. (2014, March 5). Third-graders visit Flint's Sloan Museum for full week of class in pilot learning program. *MLive.* Retrieved from https://www.mlive.com/news/flint/index.ssf/2014/03/third_graders_visit_sloan_muse.html

King's College London. (2016). *My Primary School is at the museum: Inspiring schools and museums across the UK to build museum-school partnerships.* London: Author.

Kirk, G. (1987). Changing needs in schools. In T. Ambrose (Ed.), *Education in museums: Museums in education* (pp. 19-25). Edinburgh: Scottish Museum Council.

Kisiel, J. (2005). Understanding elementary teacher motivations for science fieldtrips. *Science Education*, *89*, 936–955.

Knaflic, C. (2015). *Storytelling with data: A data visualization guide for business professionals. [electronic resource]*. John Wiley & Sons. Retrieved from https://search-ebscohost-com.ezp.lib.unimelb.edu.au/login.aspx?direct=true&db=cat00006a&AN=melb.b7255964&site=eds-live&scope=site

Koutamanis, A. (2006). Buildings and affordances. In J.S. Gero (Ed.), *Design Computing and Cognition '06* (pp. 345–364). Dordrecht, The Netherlands: Springer.

Lampert, M. (2015). *Deeper teaching. Students at the center: Deeper learning research series.* Boston, MA: Jobs for the Future. Retrieved from https://studentsatthecenterhub.org/wp-content/uploads/2015/12/Deeper-Teaching-120315.pdf

Lave, J. (1988). *Cognition in practice: Mind, mathematics, and culture in everyday life*. Cambridge, MA: Cambridge University Press.

Leander, K. M., Phillips, N. C., Taylor, K. H., Nespor, J., & Lewis, C. (2010). The changing social spaces of learning: Mapping new mobilities. *Review of Research in Education, 34*, 329-394.

Lemon, N. (2011). Arts and technology. In C. Klopper & S. Garvis (Eds.), *Tapping into classroom practice of the arts: From inside out* (pp 97-132). Mt Gravatt, Australia: Post Pressed.

Lemon, N. (2016). Young children photographing their learning to share their lived experiences of the learning environment. In S. Garvis & N. Lemon (Eds.), *Understanding digital technologies and young children: An international perspective* (pp 46-58). New York: Routledge.

Lemon, N. & Garvis, S. (2014) Perceptions of pre-service teachers value of art museums and galleries. *Journal of Museum Education*, *39*(1), 28-41. doi:10.1080/10598650.2014.11510793

Leonardi, P. M. (2010). Digital materiality how artifacts without matter, matter? *First Monday*, *15*(6), 7 June 2010. Retrieved from https://firstmonday.org/ojs/index.php/fm/article/view/3036/2567

Leonardi, P. M. (2011). 'When flexible routines meet flexible technologies: affordance, constraint, and the imbrication of human and material agencies', *MIS Quarterly, 35*(1), 147–167.

Leonardi, P. M., & Barley S. R. (2008). Materiality and change: challenges to building better theory about technology and organizing'. *Information and Organization, 18*, 159–176.

Lindberg A., & Lyytinen, K. (2013). Towards a theory of affordance ecologies. In F. de Vaujany, & N. Mitev (Eds.), *Materiality and space: Organizations, artefacts and practices* (pp. 41-61). New York, NY: Palgrave Macmillan.

Lord, B. (2007). *The manual of museum learning*. Lanham: Rowman & Littlefield.

Lubar, S. & Kendrick, K. (n.d). *Looking at artifacts, thinking about history*. Retrieved from http://www.smithsonianeducation.org/idealabs/ap/essays/looking.htm

Lundgren, L. & Crippen, K. (2019). Learning and the practice of social media in informal science education centers. *International Journal on E-Learning, 18*(1), 31-52.

Mahat, M., Bradbeer, C., Byers, T., & Imms, W. (2018). *Innovative Learning Environments and Teacher Change: Defining key concepts* (Technical Report No. 3). Melbourne: University of Melbourne, LEARN. Retrieved from http://www.iletc.com.au/publications/reports/

Mahat, M., Bradbeer, C., Cattlin, J., & Imms, W. (2019). Validating the ILETC's Teacher Transition Pathway. In W. Imms & M. Mahat (Eds.), *What Are Teachers Doing (Well) When Transitioning From Traditional Classrooms T Innovative Learning Environments?* (pp. 13-26). Retrieved from file:///C:/Users/evillafranca/Downloads/Transitions2018Book_PrePress_Final_web%20(1).pdf

Mahat, M., Grocott, L, & Imms, W. (2017) “In the real world…”: Teachers’ perceptions of ILEs. *Technical report of the ILETC phase 1 teacher workshops*. Retrieved from: http://www.iletc.com.au/publications/reports/

Maier, J., Fadel, G., & Battisto, D. (2009). An affordance-based approach to architectural theory, design, and practice. *Design Studies, 30*(4), 393–414.

Manning, C., Verenikina, I., & Brown, I. (2010) *Learning with the arts: What opportunities are there for work-related adult learning? Journal of Vocational Education and Training, 62*(3), 209-224. doi:10.1080/13636820.2010.493221

Mannion, G., Fenwick, A., & Lynch, J. (2013). Place-responsive pedagogy: Learning from teachers’ experiences of excursions in nature. *Environmental Education Research, 19*(6), 792-809.

Martinez, M., & McGrath, D. (2015). Leaping the college-ready gap: What can be learned from schools that focus on deeper learning. *The State Education Standard, 15*(2), 15-20.

Marton, F. A., & Säljö, R. A. (1976). On qualitative differences in learning-II outcome as a function of the learner’s conception of the task. *British Journal of Educational Psychology, 46*, 115- 127. doi:10.1111/j.2044-8279.1976.tb02304.x

Massey, D. B. (2005). *For space*. London: Sage

Massumi, B. (1987). Notes on the translation and acknowledgements. In G. Deleuze & F. Guattari (Eds.), *A thousand plateaus* (pp. xvi-xix). Minneapolis: University of Minnesota Press.

Matusov, E., & Rogoff, B. (1995). Evidence of development from people’s participation in Communities of learners. In J. Falk & L. Dierking (Eds.), *Public institutions for personal learning: Establishing a research agenda (pp.* 97-104). Washington DC: American Association of Museums.

Maxwell-Stewart, H. (2011) To fill dishonoured graves? Death and convict transportation to colonial Australia. *Tasmanian Historical Research Association 58*(1), 17–32.

Mayer, M.M. (2012). Looking outside the frame: Demythifying museum education. *Art Education, 65*(4), 15-18.

McCarthy, C. (2015). Introduction: Grounding museums studies: Introducing practice. In C. McCarthy (Ed.), *Museum Practice* (pp. xxxvii-ii). Chichester, West Sussex, UK: John Wiley & Sons Ltd.

McComas, W. F. (2006). Science teaching beyond the classroom. *Science Teacher, 73*(1), 26-30.

McGregor, J. (2003). Making spaces: Teacher workplace topologies. *Pedagogy, Culture & Society, 1*(3), 353-378.

McGrenere, J., and Ho, W. (2000). Affordances: Clarifying and evolving a concept. *Graphics Interface* (pp. 179–186).

McKenna, T. O. M. (2011). You are where you sit: Uncovering the lessons of classroom furniture. *Rethinking Schools, 25*(1), 47- 50.

Mehta, J., & Fine, S. (2015). *The why, what, where, and how of deeper learning in American secondary schools. Students at the Center, Deeper Learning Research Series.* Boston, MA: Jobs for the Future. Retrieved from https://studentsatthecenterhub.org/wp-content/uploads/2010/01/The-Why-What-Where-How-121415.pdf

Merriam, S. B. (1988). *Case study research in education: A qualitative approach.* San Francisco, CA, US: Jossey-Bass.

Merrill, M.D. (2002). First Principles of Instruction. *Educational Technology Research and Development 50*(3), 43–59.

Merritt, E. (2015, September 08). Trending now: "Museum Schools"[Web log post]. Retrieved from https://www.aam-us.org/2015/09/08/trending-now-museum-schools/

Miller, D. (2008). *Teaching with intention: Defining beliefs, aligning practice, taking action, K*-5. Portland, ME: Stenhouse Publishers.

Moll, L.C., & Whitmore K.F. (1993). Vygotsky in classroom practice. Moving from individual transmission to social transaction. In E.A. Forman, N. Minick, & C.A. Stone (Eds.), *Contexts for Learning* (pp. 19-42). New York: Oxford University Press.

Moll, L.C., Tapia, J., & Whitmore, K.F. (1993). Living knowledge: The social distribution of cultural sources for thinking. In G. Salomon (Ed.), *Distributed Cognitions* (pp. 139-163). Cambridge, UK: Cambridge University Press.

Morrow, L. M., & Rand, M. K. (1991). Promoting literacy during play by designing early childhood classroom environments. *Reading Teacher, 44*(6), 396.

Mulcahy, D. (2016). 'Sticky' learning: Assembling bodies, objects and affects at the museum and beyond. In J. Coffey, S. Budgeon, & H. Cahill (Eds.), *Learning bodies: The body in youth and childhood studies*. Dordrecht: Springer.

Museum Association. (n.d.). *My Primary School is at the Museum.* Retrieved from https://www.museumsassociation.org/museums-change-lives/16082017-my-primary-school-is-at-the-museum

Museum pedagogy in the classroom. (n.d.). Retrieved from https://museumcuny.commons.gc.cuny.edu/

Naghshineh, S., Hafler, J. P., Miller, A. R., Blanco, M. A., Lipsitz, S. R., Dubroff, R. P., … Katz, J. T. (2008). Formal art observation training improves medical students' visual diagnostic skills. *Journal of general internal medicine, 23*, 991–997. doi:10.1007/s11606-008-0667-0

National Association of Museum Schools (2019). *History.* Retrieved https://www.museumschools.org/history/

National Museum of Australia. (2018). *National Museum of Australia 17-18 Annual Report.* Retrieved from https://www.nma.gov.au/__data/assets/pdf_file/0009/591984/NMA-AR-2017-18-WEB-spreads-bmd.pdf

National Research Council (NRC). (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century.* Washington, DC: The National Academies Press.

Neill, A. (2010). Providing tailored educational interaction with cultural treasures: A study of museum docents. *Journal of Adult and Continuing Education, 12*(2), 67-82. doi: 10.1177/147797141001600206

Nelson, K. R. (2015) Application of Merrill's First Principles of Instruction in a Museum Education Context. *Journal of Museum Education, 40*(3), 304-313. doi:10.1179/1059865015Z.000000000106

New Pedagogies for Deep Learning: A Global Partnership. (2019). *Deep learning competencies.* Retrieved from https://www.npdl.global/making-it-happen/

Newton, C. (2009). Disciplinary dilemmas: Learning spaces as a discussion between designers and educators. *The Australasian Journal of Philosophy in Education, 17*(2), 7–27.

Norman, D. (2002) *The Design of Everyday Things*. New York, NY: Basic Books.

Norman, D. (2013) *The design of everyday things: Revised and expanded edition.* New York, NY: Basic Books.

Nottingham, Anitra (2016, October 5). The swamp of sadness. {Web log post} Retrieved from https://thesiswhisperer.com/2016/10/05/the-swamp-of-sadness/

Nygaard, C., Højlt, T., & Hermansen. (2008). *Higher Education* 55(1), 33-50. https://doi.org/10.1007/s10734-006-9036-2

Organisation for Economic Cooperation and Development (OECD). (2005). *Definition and selection of competencies: Executive summary*. Paris, France: Author. Retrieved from http://www.oecd.org/pisa/35070367.pdf

OECD. (2016). *Global competency for an inclusive world*. Paris, France: Author. Retrieved from https://www.oecd.org/education/Global-competency-for-an-inclusive-world.pdf

OECD. (2017). *The OECD handbook for innovative learning environments.* Paris, France: Author. doi:9789264277274-en

Ogden, J. L., Lindburg, D. G., & Maple, T. L. (1993). The Effects of Ecologically Relevant Sounds on Zoo Visitors. *Curator 36*(2), 147–56.

O'Toole, J. & Beckett, D. (2010). *Educational research: Creative thinking and doing*. Melbourne, Victoria: Oxford University Press.

Oliver, C., Fergusson, J., Mahony, P., Oliver, J., Kingsley, I., Browne, C. (2015). The Mars Lab: Connecting authentic science with the classroom. *SCAN: The Journal for Educators*, *34*(1), 26-35.

Orlikowski, W.J., & Scott S.V. (2008). Sociomateriality: Challenging the separation of technology, work and organization. *The Academy of Management Annals, 2*(1), 433–474.

Osborne, R.M. (2014). *An ecological approach to educational technology: Affordance as a design tool for aligning pedagogy and technology* (Doctoral Thesis, University of Exeter). Retrieved from https://ore.exeter.ac.uk/repository/handle/10871/16637

Pask, G. (1976), Styles and Strategies of Learning. *British Journal of Educational Psychology, 46*. 128–148. doi:10.1111/j.2044-8279.1976.tb02305.x

Pask, G., & Scott, B. C. E. (1972). Learning strategies and individual competence. *International Journal of Man-Machine Studies, 4*(3), 217-253. doi:10.1016/S0020-7373(72)80004-X

Patton, M. Q. (2002). *Qualitative Research and Evaluation Methods (3rd Ed.).* Thousand Oaks, CA: Sage.

Paris, S. (Ed.), *Perspective in object centered learning in museums*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Postareff, L., Parpala, A., & Lindblom-Ylänne, S. (2015). Factors contributing to changes in a deep approach to learning in different learning environments. *Learning Environments Research, 18*(3), 315-333.

Pea, R.D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions: psychological and educational considerations*. New York: Cambridge University Press.

Peralta, E. (2015). The presence of the past: Imagination and affect in the Museo do Oriente, Portugal. In A. Witcomb, & K. Message (Eds.), *Museum theory* (pp. 304-320). Chichester, West Sussex, UK: John Wiley & Sons Ltd.

Pfaffenberger, B. (1992). Technological Dramas. *Science, Technology & Human Values*, 17(3), 282–312.

Phipps, M. (2010). Research trends and findings from a decade (1997–2007) of research on informal science education and free-choice science learning. *Visitor Studies*, *13*(1), 3-22. doi: 10.1080/10645571003618717

Pickering, A. (1995). *The mangle of practice: Time, agency, and science*. Chicago: University Chicago Press.

Plomp, T. (2009). Educational design research: An introduction. In T. Plomp, & Nieveen, N. (Eds.), *An introduction to educational research* (pp. 9-35). Netherlands: Netherlands Institute for Curriculum Development.

Randi Korn & Associates, Inc. (2015). *Summary of results: Survey of single-visit K-12 art museum programs* (Unpublished report). Reston, VA: National Art Education Association.

Ramirez-Andreotta, M. D., Brody, J. G., Lothrop, N., Loh, M., Beamer, P. I., & Brown, P. (2016). Improving environmental health literacy and justice through environmental exposure results communication. *International Journal of Environmental Research and Public Health*, *13*(7), 690–717.

Ramsden, P. (1979). Student learning and perceptions of the academic environment. *Higher Education, 8*, 411-427.

Ramsden, P., & Entwistle, N. J. (1981). Effects of academic departments on students' approaches to studying. *British Journal of Educational Psychology, 51*(3), 368-383. doi:10.1111/j.2044-8279.1981.tb02493.x

Rennie, L. (2016). John Falk and Lynn Dierking: Building the field of informal/free-choice science education. *Cultural Studies of Science Education, 11*(1), pp.127-146. doi:10.1007/s11422-015-9707-3

Riegel, U., & Kindermann, K. (2016). Why leave the classroom? How field trips to the church affect cognitive learning outcomes. *Learning and Instruction, 41,* 106-114.

Roberts, L. (1991). The elusive qualities of 'affect'. *The Journal of Museum Education*, *1*, 17-18.

Roberts, L. C. (1997). *From knowledge to narrative: Educators and the changing museum*. Washington, DC: Smithsonian Institution Press.

Rogoff, B. (1990). Apprenticeship in thinking: Cognitive development in social context. New York: Oxford University Press.

Roseler, K., & Dentzau, M. (2017) Using Drawings to Demonstrate Informal Science Learning Experiences through the Contextual Model of Learning. In P. Katz (Ed), *Drawing for Science Education*. Rotterdam: SensePublishers doi.org/10.1007/978-94-6300-875-4_11

Ross, M., Hancock, R., & Bagnall, K. (2004). Pedagogy in a public space: Children and adults learning together at Tate Modern. *Forum*, *46*(1), 24-27.

Rose, J., & Jones, M. (2005). The double dance of agency: a socio-theoretic account of how machines and humans interact. *Systems, Signs and Actions, 1*(1), 19–37.

Rose, J., Jones, M., & Truex, D. (2005). Socio-theoretic accounts of IS: The problem of agency. *Scandinavian Journal of Information Systems, 17*(1), 133–152.

Robins, C. (2005). Engaging with curating. *International Journal of Art & Design Education, 24*(2), 149-158.

Saltmarsh, S., Chapman, A., Campbell, M., & Drew, C. (2015). Putting “structure within the space”: Spatially un/responsive pedagogic practices in open-plan learning environments. *Educational Review*, (3), 315 327.

Santrock, J. (2009) *Educational Psychology.* Boston: McGraw-Hill.

Saumure, K. & Given, L. M. (2008). Convenience sample. In L. M. Given (Eds.), *The SAGE Encyclopedia of Qualitative Research Methods* (pp. 124-125). Thousand Oaks, CA: Sage.

Saxe, G.B. (1990). *Culture and Cognitive Development: Studies in Mathematical Understanding*. Hillsdale, NJ: Erlbaum.

Schrittesser, I., Gerhartz-Reiter, S., & Paseka, A. (2014). Innovative Learning Environments: About traditional and new patterns of learning. *European Educational Research Journal*, *13*(2), 143–154. doi:10.2304/eerj.2014.13.2.143

Sederberg, K. (2013). Bringing the museum into the classroom, and the class into the museum: An approach for content-based instructions. *Teaching German, 46(*2), 251-262. doi:10.1111/tger.10144

Serrell, B. (2015). *Exhibit labels: An interpretive approach*. Lanham, Maryland: Rowman & Littlefield.

Sheridan, K., Halverson, E., Litts, B., Brahms, L., Jacobs-Priebe, L., & Owens, T. (2014). Learning in the making: A comparative case study of three makerspaces. *Harvard Educational Review, 84*(4), 505-531. doi:org.ezp.lib.unimelb.edu.au/10.17763/haer.84.4.brr34733723j648u

Shulman, L.S. (2004). *The wisdom of practice: essays on teaching, learning, and learning to teach.* San Francisco, CA: The Carnegie Foundation for the Advancement of Teaching, Jossey-Bass.

Simons, H. (2009). *Case study research in practice*. Los Angeles, CA: Sage.

Smith, L. (1978). An evolving logic of participant observation, educational ethnography and other case studies. *Review of Research in Education 6*(1), 316-377.

Smith, T. W., & Colby, S. A. (2007). Teaching for deep learning. *The Clearing House, 80*(5). 205-209.

Soja, E. W. (2014). *My Los Angeles: From urban restructuring to regional urbanization*. Berkeley, California: University of California Press.

Sommer, R. (1977). Classroom layout. *Theory into Practice*, 16(3), 174-175.

Sommer, R. & Olsen, H. (1980). The soft classroom. *Environment and Behavior, 12*(1), 3-16.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks: Sage Publications, c1995.

Strong-Wilson, T., & Ellis, J. (2007). Children and place: Reggio Emilia's environment as third teacher. *Theory into Practice, 46*(1), 40-47.

Tran, L. U. (2007), Teaching science in museums: The pedagogy and goals of museum educators. *Science Education, 91,* 278-297. doi:10.1002/sce.20193

Terrassa, J., Hubard, O., Holtrop, E., & Higgins-Linder, M. (2016). *Impact of art museum programs on students: Literature review.* Alexandria, VA: National Art Education Association.

Tenenbaum, H.R., Rappolt-Schlichtmann, & G., VogelZangerc, V. (2004). Children's learning about water in a museum and in the classroom. *Early Childhood Research Quarterly, 19*(1), 40-58. doi:10.1016/j.ecresq.2004.01.008

The United Kingdom Parliament (n.d). *Churchill and the Commons Chamber*. Retrieved from http://www.parliament.uk/about/living-heritage/building/palace/architecture/palacestructure/churchill/

Tondeur, J., Herman, F., de Buck, M., & Triquet, K. (2017). Unraveling entangled Spaces and practices: teacher's views on the evolving material classroom. *European Journal of Education Research Development and Policy*, *52(3),* 280-294. doi:10.1111/ejed.12228

Tröndle, M., Greenwood, S., Bitterli, K., & van den Berg, K. (2014). The effects of curatorial arrangements. *Museum Management & Curatorship*, *29*(2), 140-173.

Turvey, M. T. (2012). From physical education to physical intelligence: 50 years of Perception-Action by Michael T. Turvey. *Avant. The Journal of the Philosophical-Interdisciplinary Vanguard*, 3(2), 128–138.

Vavrus, F., & Bartlett, L. (2013). Testing and teaching. In F. Vavrus & L. Bartlett (Eds.), *Teaching in tension: International pedagogies, national policies, and teachers' practices in Tanzania* (93-114). Rotterdam: Sense.

Veltri, S., Banning, J. H., & Davies, T. G. (2006). The community college classroom environment: Student perceptions. *College Student Journal, 40*(3), 517-527.

Villafranca, E. (2016). Understanding affordances in museum education context In H. Micheltree, B. Cleveland, & W. Imms (Eds.),: *Proceedings of the Third Annual International Learning Environments Research Higher Degree Symposium* (pp. 113-118).

Villafranca, E. (2019, November 16a). Pedagogical affordances (Version 1). figshare. doi:10.6084/m9.figshare.10314617.v1

Villafranca, E. (2019, November 16b). LEAD Framework (Version 1). figshare. doi:10.6084/m9.figshare.10315385.v1

Villafranca, E., Lim-Yuson, N., Herrera, M. V., Natividad, P.J., Francisco, R., Buencamino, Y. ... Cruz, R. (2017). *Making museums work: A Zero-In handbook.* Philippines: Eugenio Lopez Foundation, Inc.

Vilar, E., F. Rebelo, & Noriega P. (2011). Environmental affordances as a way to help in the design of videogame worlds. In A. Marcus (Ed.), *Design, User Experience, and Usability* (pp. 323–331). doi: 10.1007/978-3-642-21675-6_38

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes.* Cambridge: Harvard University Press.

Watson, S. (2015). Emotions in the history museum. In A. Witcomb & K. Message (Eds.), *Museum theory* (pp. 283-301). Chichester, West Sussex, UK: John Wiley & Sons Ltd.

Walker, K. (2010) *Designing for meaning making in museums. Visitor-constructed trails using mobile digital technologies* (Doctoral Thesis, University of London). Retrieved from https://discovery.ucl.ac.uk/id/eprint/10006479/8/534816_Redacted.pdf

Warburton, K. (2003). Deep learning and education for sustainability. *International Journal of Sustainability in Higher Education, 4*(1), 44-56.

Warkentien, S., Charles, K., Knapp, L., & Silver, D. (2017). *Charting the progress of the Hewlett Foundation's deeper learning strategy 2010–2015*. North Carolina: RTI International.

Westbrook J., Durrani N., Brown R., Orr D., Pryor J., Boddy J., & Salvi F. (2013) P*edagogy, curriculum, teaching practices and teacher education in developing countries* (Final Report). Education Rigorous Literature Review. Department for International Development.

Wilde M. (2007). Das Contextual Model of Learning – ein Theorierahmen zur Erfassung von Lernprozessen in Museen. Das contextual model of learning ein theorierahmen zur erfassung von lernprozessen. In D. Krüger, & H. Vogt (Eds.), *Theorien in der biologiedidaktischen forschung* (pp. 165-176). Berlin, Heidelberg, New York: Springer-Verlag

Williams, P. (1988). The Work of the Denver Meeting. *The Journal of Museum Education*, *13*(3), 7.

William and Flora Hewlett Foundation. (2013). *Deeper learning competencies: April 2013*. Retrieved from https://www.hewlett.org/wp-content/uploads/2016/08/Deeper_Learning_Defined__April_2013.pdf

Willis, J. W. (2007). *Foundations of qualitative research: Interpretive and critical approaches*. Thousand Oaks, CA: Sage.

Wilson, V. (2014). Research methods: Triangulation. *Evidence Based Library and Information Practice, 9*, 74-75. Retrieved from http://ejournals.library.ualberta.ca

Winstanley, C. (2014). Spaced out: The impact of museum spaces on teaching and learning. *Education Sciences and Society (Special Edition – Arts and Museum Education), 5*(2), 65-82.

Wolff, A., & Mulholland, P. (2013). *Curation, curation, curation.* Paper presented at the Narrative and Hypertext (NHT'13), 1-3 May 2013, Paris, France.

Wood, A. (2017). Selling new learning spaces –flexibly anything for the 21st century. In L. Benade & M. Jackson (Eds.), *Transforming education: Design, technology, government* (pp. 95–106). Singapore: Springer.

Woolner, P. (2010). *The design of learning spaces*. New York: Continuum International Pub. Group.

Xiao, Y. (2005). Artifacts and collaborative work in healthcare: Methodological, theoretical, and technological implications of the tangible. *Journal of Biomedical Informatics, 38*(1), 26–33.

Xiao, Y., Schenkel, S., Faraj, S., Mackenzie, C., & Moss J. (2007). What whiteboards in a trauma center operating suite can teach us about emergency department communication. *Annals of Emergency Medicine*, 50(4), 387–95.

Yager, R. E. (1991). The Constructivist learning model: Towards real reform in science education. *The Science Teacher, 58*(6). 52.

Yin, R. K. (2009). *Case study research: design and methods*. Thousand Oaks, California: Sage.

Yoo, J. (2019). *Constructivist approaches in museum tour and workshop school programs* (Doctoral dissertation, Columbia University). Retrieved from https://academiccommons.columbia.edu/doi/10.7916/d8-g946-8p91

Yuan, K., & Le, V. (2014). *Measuring Deeper Learning Through Cognitively Demanding Test Items: Results from the Analysis of Six National and International Exams*. RAND Corporation. Retrieved from http://www.jstor.org/stable/10.7249/j.ctt5vjvq3

Zammuto, R., Griffith, T., Majchrzak, A., Dougherty, D., & Faraj, S. (2007) Information technology and the changing fabric of organization. *Organization Science*, *18*(5), 749–762.

Zeiser, K., Taylor, J, Rickles J., & Garet, M. (2014). *Evidence if deeper learning outcomes. Findings from the Study of Deeper Learning Opportunities and Outcomes* (Report 3). Washington, DC, and New York, NY: American Institutes for Research and the Research Alliance for New York City Schools

APPENDIX A: OBSERVATION CHECKLIST

Environment-Affordance-Deep Learning Observation Checklist

Participant:				Number of students:		Date		**NOTES:**
Affiliation:				Level: primary / secondary		Start		
Type: museum/school				Subject:		End		
	P		1	2	3	4	5	
1		Text						
2		Image						
3		Moving Image						
4		Object (Installed)						
5		Object (Carried)						
6		Technology (Installed)						
7		Technology (Carried)						
6		Interactive component						
4		Spatial Organisation (display)						
3		Natural environment						
2		Sensory stimuli						
1		Others						
1		Experiential Learning						
2		Collaboration						
3		Authenticity						
4		Critical thinking						
5		Choice						
6		Creativity						
1		Information transmission						
2		Information aid						
3		Relevance						
4		Shift in Authority						
5		Emotional Resonance						
5		Visual engagement						
4		Curiosity/imagination						
3		Movement						
2		Sensory experience						
1		Others						
1		Show personal interest						
2		Reveal topic structure						
3		Depth of coverage						
4		Correct misconceptions						
5		Ask questions						
6		Encourage problem solving						
6		Require thoughtful reflection						
5		Promote combination of ideas						
4		Connect new-prior knowledge						
3		Build positive atmosphere						
2		Affirm learning from mistakes						
1		Articulate ILO						
		Start						
		End						

Author/s:
Villafranca, Ethel

Title:
Curated learning: a pedagogical approach to maximise learning environments for students' deep learning

Date:
2019