

## Indigenous Knowledge Sharing and Botanical Literacies in Early Childhood Education

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### ABSTRACT

This study contributes to the research in Early Childhood Education for Sustainability (ECEfS) by exploring a case study of two Western Australian early childhood education classes who welcomed an Indigenous Elder to share their expertise about the native plants in the schools' bush space. The findings from this study demonstrate the impact Indigenous perspectives had on teacher's and children's relationship with the bush and the development of their botanical literacies. Indigenous peoples in Australia, and across the world have botanical practices that have existed for tens of thousands of years. This study acknowledges botany as a settler colonial practice and contemplates changes to botanical practices and pedagogies that include Indigenous ways of knowing, being and doing.

**Keywords:** botanical literacies, early childhood education, indigenous knowledges, native plants, plant knowledge

South-west Western Australia is a one of only 34 biodiversity hotspots in the world (Bellard et al., 2014). The population of this area is 3.9% Indigenous (Australian Bureau of Statistics, 2016). After over 230 years of British colonisation, the Indigenous<sup>1</sup> languages of Australia have either become extinct or are severely endangered (Sivak et al., 2019). With this decline in Indigenous languages, comes a loss of words and stories that encode specific information about the local habitats, flora and fauna, including plant uses and medicinal information (Kimmerer, 2013; Merritt et al., 2021). Also endangered, are the vast number of plants in the area, with 40% of these plants being classified as at risk of extinction (Bradshaw, 2012; Cochrane et al., 2010) The Traditional Owners of the land on which this study took place are the Noongar people, like other Aboriginal and Torres Strait Islander people, they have developed systems and practices that have enabled them to live with a deep interconnectedness with 'Country' continuously for more than 60,000 years, making them the oldest continuing living culture on earth (Sivak et al., 2019). The knowledge that this connection brings is vital for the care and protection of local environments, therefore should be embedded in the curriculum of local schools. Pedagogical systems and scientific practices often represent the values of the society where they were developed. In Australia, such systems have developed predominantly to reflect Western European ways of knowing and understanding over other ways of knowing and understanding

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<sup>1</sup> The authors acknowledge that the term Indigenous is a term introduced to Australia through legislation and is not the original or preferred name of the first inhabitants. Similarly, Aboriginal is a word that is used in this paper. We acknowledge the Traditional Owners and many language groups that make up the diverse peoples who are the first Australians.

(Kinzel, 2020; Pacini-Ketchabaw, 2013). An example of this is the overlaying of European seasons on Australian landscapes without reference to local knowledges. We need to ensure local, Indigenous ways of knowing remain strong and continue to be passed on to future generations. In Australian early childhood education (ECE), a commitment to embedding Aboriginal and Torres Strait Islander histories and cultures in the curriculum is mandated by the Australian Government through the Australian Curriculum (Australian Curriculum and Reporting Authority, 2019) and the Early Years Learning Framework (Department of Education and Training, 2019). These documents recommend that the practice of embedding Indigenous perspectives should occur through consultation and partnerships with Aboriginal and Torres Strait Islander people. Consultation can be problematic however, with some researchers suggesting that inviting a Traditional Owner into an ECE program to share Indigenous knowledge could be seen as tokenistic to fill a 'need' of the curriculum rather than meaningfully embedding Indigenous knowledge systems (Grace & Trudgett, 2012; Kinzel, 2020; Merritt et al., 2021; Miller, 2015).

### **Early Childhood Education for Sustainability**

There has been a recent international focus on teaching Early Childhood Education for Sustainability (ECEfS) through practices involving interactions with First Nations People (Elliott & Davis, 2009; Ritchie, 2017). Lived experiences within a particular place enables humans to gain a deeper understanding of, and connection with that place (Rowan, 2017). In Australia, this has been reflected by a movement towards bush kindergarten and On Country Learning in Early Childhood Education (ECE) (Beasley et al., 2021; Elliott & Chancellor, 2014; Jackson-Barrett & Lee-Hammond, 2018).

Early Childhood Education for Sustainability (ECEfS) involves the understanding that different people have different connections with the land and waterways and that any separation between land, people, and culture is a false separation (Ritchie, 2017). From this perspective, learning is integral to being and knowing. On Country Learning (OCL) shares a similar perspective and offers a framework for engaging in environmental education that opens more inclusive social, cultural, spiritual, and ecological spaces for educational practice. Country is more than 'the natural environment'. It is better understood as an interconnected web of social, ecological, and spiritual relationships (Jackson-Barrett & Lee-Hammond, 2018; Johnston, 2020; Somerville et al., 2019; Whitehouse et al., 2014).

In Australia, a study of young Aboriginal children partaking in OCL in metropolitan Perth was able to reflect the reciprocity of the relationship between nature and humans as the program was led by Traditional Owners and focused on the children's connection to Country, identities and cultural knowledge (Jackson-Barrett & Lee-Hammond, 2018). The research measured the wellbeing of six Aboriginal children both in the early childhood education classroom and 'on Country' using the Laevers' Wellbeing and Involvement Scale (Laevers, 2015) and demonstrated significantly higher levels of involvement when the children were learning outdoors. This study recommended a rethinking of the way the curriculum is delivered in Australian schools (Jackson-Barrett & Lee-Hammond, 2018). Although the above research involves learning on Country with Traditional Owners, there has been little research about the specific teaching of plants or botany with Traditional Owners in Australia.

### **Botanical Literacies in Early Childhood Education**

The term 'botanical literacy' was first described by Uno (2009, p. 1753) in his development of four progressive levels of knowledge around botanical concepts, terms and behaviours, which he framed through research focused on his United States college botany students. These levels were further developed for use with young children in a study in Perth, Western Australia, which suggested a shift in the term to 'botanical literacies' (Beasley et. al., 2021), recognising young children as learners who create meaning using a diverse range of modes and materials, thus the term botanical literacies recognises young children's 'multiliteracies' (Hesterman, 2013). Beasley et. al. (2021) adapted Uno's levels and derived the following table to describe botanical literacies in ECE:

Table 1  
Levels of Botanical Literacies in ECE

Nominal (some ideas)	Functional (many relevant ideas)	Relational (linked ideas)	Multi-dimensional (extended ideas)
<ul style="list-style-type: none"> <li>Names 5 or less plants</li> <li>Some misconceptions</li> </ul>	<ul style="list-style-type: none"> <li>Names more than 5 plants</li> <li>Memorized facts but not understood</li> </ul>	<ul style="list-style-type: none"> <li>Explains plants and concepts in their own words</li> <li>Undertakes botany without prompting</li> <li>Curious and intrinsically motivated to understand botany</li> </ul>	<ul style="list-style-type: none"> <li>Explains plants as a part of a larger eco-system</li> <li>Curious and intrinsically motivated to understand botany</li> <li>Makes ethical decisions relating to plants</li> </ul>

Source: Beasley et al., 2021 p. 10

To complement these levels of botanical literacies in ECE, the researchers (Beasley et. al., 2021) also established a framework for the ideal conditions for the development of botanical literacies, which included regular time in nature, hands-on, sensory exploration and inquiry, having a ‘botanically interested’ and passionate adult with the students and including Indigenous Knowledges in the curriculum (Beasley et. al., 2021).

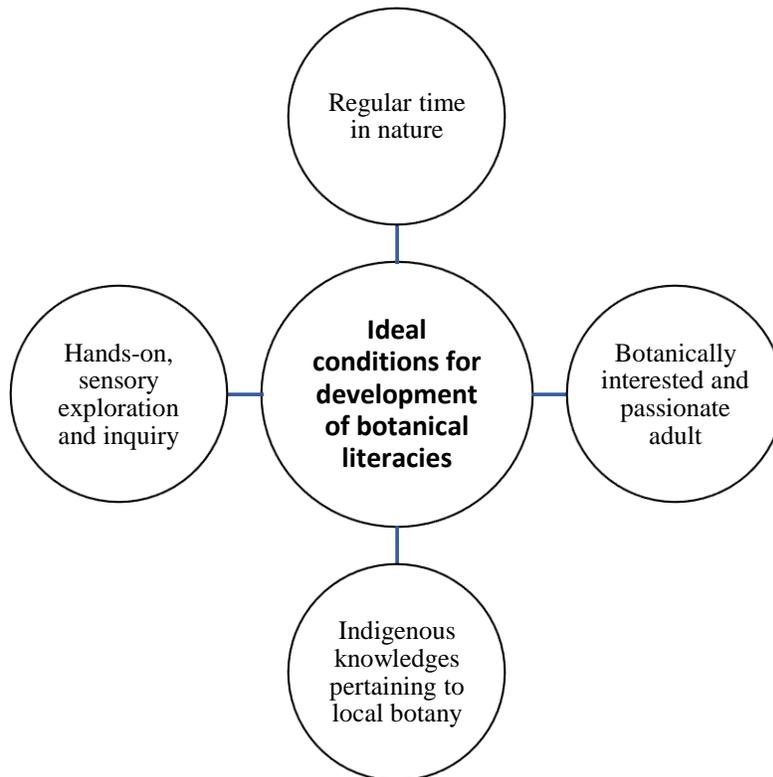


Figure 1. Framework for Developing Botanical Literacies in ECE (Beasley et.al., 2021)

This model reflects previous research around the importance of repeated visits to a specific local environment and Indigenous Knowledge sharing to enable children to learn about and form relationships with local flora and fauna (Otto & Pensini, 2017).

### **Indigenous Knowledges in the Australian Curriculum**

The infusion of Indigenous Knowledges with the formal school curriculum has been endorsed by the United Nations in the Declaration on the Rights of Indigenous Peoples (United Nations, 2007) and is recognised in Australia in the Alice Springs (Mparntwe) Education Declaration (Education Council, 2019) as well as the Australian Curriculum (Australian Curriculum and Reporting Authority, 2019). Despite these initiatives, Indigenous Knowledges are still marginalised in the Australian Curriculum (Somerville et al., 2019; Whatman et al., 2017). At the same time, Indigenous Knowledges are being supported in some remote communities, through stories, language and local research as communities adapt to present day understandings and changes in environments (Sammel & Whatman, 2018). These knowledges are local and specific to each region, reflecting the cultural and linguistic diversity of peoples and the biodiversity of environments. In Australia, environmental scientists often work alongside local Traditional Owners to solve local environmental problems. For example, Ranger programs employ Traditional Owners who combine cultural experience and traditional land care practices to protect sacred sites and care for Country through land management (Jones et al., 2018). A similar model can be applied by teachers concerned with sustainability and have a desire to use cross-cultural collaboration to develop a respect for the natural environment (Corsiglia & Snively, 2001; Johnston, 2020).

Indigenous Knowledges recognise an inter-connection between all living and non-living things, cultivating respectful, reciprocal relationships between humans and all other elements of nature (Corsiglia & Snively, 2001; Johnston, 2020; Sammel & Whatman, 2018). In the Australian Curriculum, Aboriginal and Torres Strait Islander histories and cultures have been mandated as a priority to be taught across all learning areas and teaching resources have been developed to support teachers to do this in consultation with Indigenous education experts (ACARA, 2019). In the science curriculum, the elaboration for this priority provides context for an inquiry-based learning process that engages with Aboriginal and Torres Strait Islander histories and cultures by:

- *Acknowledging the scientific knowledge and skills of Aboriginal and Torres Strait Islander Peoples*
- *Consulting with Aboriginal and Torres Strait Islander Communities in the planning or evaluation of scientific investigations; and*
- *Collaborating with Aboriginal and Torres Strait Islander communities in mutually beneficial scientific research.* (ACARA, 2019. p. 5)

In many cultures of the world, including Australian Aboriginal and Torres Strait Islander cultures, plant knowledge has been traditionally passed down through generations of family members or Traditional Owners (Hansen & Horsfall, 2016; Taylor, 2013). The effects of colonisation in Australia have led to some of this knowledge being lost, including the names for some plants, which have been replaced with common English names and Latin botanical names (Tsing, 2005). Along with the Indigenous name for a plant, comes a vast body of intricate knowledge of the properties of the plant, its healing capabilities, its relationship to the seasons, as well as its relationship to animals and people. This body of plant knowledge is significant, and effort should be made to preserve this knowledge and educate all people about the plants native to the land where they live (Hansen & Horsfall, 2016). In an effort to infuse Indigenous Knowledge and embrace Aboriginal and Torres Strait Islander histories and cultures, it is essential to educate all Australian children on the traditional uses and names for their local native plants.

### **The Current Study**

This study was part of a broader PhD research project to develop a framework for teaching botanical literacies in ECE (Beasley et. al., 2021). The part of the study reported in this article, pertains to the impact of Indigenous

Knowledges on botanical literacies for young children and their teachers. There has been no previous study in Australia that has examined Indigenous Knowledges in teaching botanical literacies in ECE.

### Methodology

The approach taken in this research was qualitative, fitting within an interpretivist-participatory paradigm, where the understandings participants attributed to their experiences and environments were explored (Creswell, 2014). We required an approach that reflected a human experience in a specific environment under specific conditions. The aim to make meaning from these particular conditions fits within qualitative research as there were no pre-conceived variables to be measured and we sought to create an understanding of these conditions, instead of explaining certainties (Willig & Stainton Rogers, 2017).

### Research Design and Recruitment

Using a multi-site case study design (Yin, 2014), this research involved two ECE classes from two separate schools in metropolitan Perth, Western Australia. Both classes and their teachers were visited fortnightly by the first author over the period of a school year, with a total of 16 visits conducted with each class. There was one two-hour visit from a Traditional Owner to each class towards the end of the research fieldwork period. The school year in Australia begins in February and continues until December. As the research was undertaken in 2020, there was a lockdown period for COVID-19, which resulted in an eight-week gap between visits to each class (April and May), between the fifth and sixth visits to the classes. The researchers do not feel COVID-19 has significantly affected the outcome of the findings due the large amount of data collected during the non-lockdown period.

Each school was chosen because they had a large area of *bush* within the school grounds that the classes already visited as a part of their regular curriculum. In Australia, the term *bush* refers to an area of natural environment that is mainly untouched by humans, and usually consists of trees, bushes and scrub (Elliott & Chancellor, 2014). Bush Hills Primary School (pseudonym) was situated in the Perth hills area with rich soil and bush consisting mainly of large trees, almost like a forest setting. Banksia Beach Primary School, situated near a beach, had sandy soil and was mainly Banksia (a local native small tree) scrub and low bushes with few trees. The diversity in the bush spaces allowed for comparison of the knowledge of specific local plants and their uses.

Using the Mosaic Approach (Clark, 2017), the lead researcher was able to elicit children's knowledge, understandings and ideas through the use of drawings, maps, tours of the bush space and conversations. This pedagogy of listening (Edwards et al., 2012; Rinaldi, 2006) enabled the researcher and teachers to listen to the children's ideas and questions about plants and then use an inquiry-based learning approach (Murdoch, 2015) to explore the bush space as well as undertake research to answer the children's questions. As an example, Banksia Beach Primary School had many Banksias in their bush space, which had dropped hundreds of Banksia seed pods on the ground. The children collected pods at different stages of growth (Figure 2) and used these to formulate inquiry questions, such as: "How do the pods grow?", "Why are the pods furry?", "How long does it take for the mouths to open?" and "How does the pod know when to open?"

A Traditional Owner was invited to visit each class to answer some of the children's questions from their inquiries and explain about Indigenous uses of the plants specific to each school's bush space. The Traditional Owner was specifically chosen for his knowledge of native plants and their traditional uses and his experience in working with school children. For ease of reading, the pseudonym Maarman (Uncle) will be used for this paper to identify the Noongar Traditional Owner. To choose Maarman, the lead researcher undertook an internet search for local Indigenous-owned businesses who provided incursions to school children with the purpose of sharing Indigenous Knowledges. In choosing a Traditional Owner who was already employed in this role, it ensured the person had experience teaching young children, had a working with children check and police clearance, and had a passion and interest in the work that was required for the purpose of this research. A business was found that offered school



Figure 2. Banksia seed pods collected by Banksia Beach students

incursions focused on plants. Maarman was then chosen by the business he worked for to be involved in the research because of his specific knowledge around native plants on Noongar Country. The business Maarman was employed by was paid their regular rate for an incursion visit to a school, by the lead researcher. Using a local Indigenous-owned business could make this research model transferable to other locations, as there are many Indigenous-owned businesses around Australia that offer similar services and are available to schools.

#### Data Collection

The children's and teacher's experiences and learning before, during and after visits with Maarman were documented and analysed. Data were collected during visits to the school's bush space, through teacher interviews and from strategies such as children's drawings drawn from the Mosaic Approach (Clark, 2011; Clark, 2017). Interviews with the two teachers were undertaken both before the school year began and at the end of the school year. These interviews enquired about the teacher's plant knowledge and prior experiences, their teaching practices in the bush space. The final interview also reflected on the impact Maarman's visit. The questions in both sets of interviews were relatively the same to enable a comparison of the teacher's knowledge and understanding before and after the research project implementation. Maarman's conversations with the children and teachers during the visit were audio recorded and later transcribed.

#### Data Analysis

To critically reflect on the impact of Indigenous perspectives on children's botanical literacies, comparisons were made between the children's observed behaviours in the bush space before Maarman's visit and after the visit. Transcripts from Maarman's visit with the children as well as the data from the children's bush visits before and after their time (2-3 hours) with Maarman were read and then revisited for the author's familiarisation. The teachers collaborated by confirming the accuracies of the transcripts and the data collected from the children. The second and third author were involved in discussions around changes in children's observed behaviours and understandings of the plants in the bush space before and after Maarman's visit.

To analyse the qualitative data in terms of changes in botanical literacies, codes developed by Beasley et. al. (2021), as explained in Table 2, were applied to the data.

Table 2

*Revised Levels of Botanical Literacies for ECE (Beasley et al., 2021) with Codes*

	Level 1. Nominal (some ideas)	Level 2. Functional (many relevant ideas)	Level 3. Relational (linked ideas)	Level 4. Multi-dimensional (extended ideas)
Knowledge (K)	Names 5 or less plants (K1)	Names more than 5 plants (K2)	Explains plants and concepts in their own words (K3)	Explains plants as a part of a larger ecosystem (K4)
Understanding (U)	Some misconceptions (U1)	Memorized facts but not understood (U2)	Undertakes botany without prompting (U3)	Makes ethical decisions relating to plants (U4)
Behaviours (B)	Seems disinterested (B1)	Seems mostly disinterested (B2)	Curious and intrinsically motivated (B3)	Curious and intrinsically motivated Excited (B4)

Children's and teacher's understandings were coded and analysed to examine different levels of learning and understanding and changes in behaviour towards plants over the course of the research period. This enabled us to record any observable changes in botanical literacies in the children and the teachers. Table 3 provides an excerpt from the coded interview with the teacher from Bush Hills Primary School at the end of the research. The teacher explained her plant knowledge had 'vastly improved'. She shared that she enjoys plants and photographing plants she has not seen before for pleasure, demonstrating she is curious and intrinsically motivated, which is a level 4, multi-dimensional behaviour in relation to her botanical literacies.

Table 3

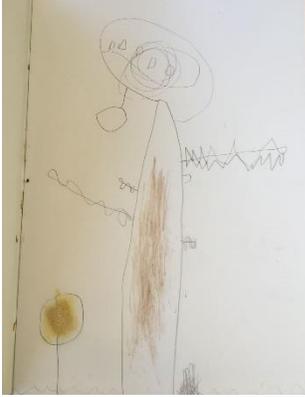
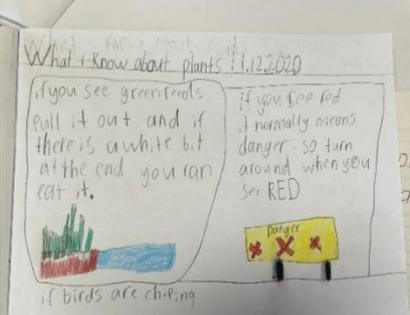
*Excerpt of Coded Interview with the Teacher from Bush Hills Primary School*

Transcript	Coding
<b>R:</b> Okay. So can you tell me about your plant knowledge now compared to the beginning of the year?	
<b>Teacher:</b> Vastly improved plant knowledge. I think I've mostly connected more of the groupings than the names. Like being able to see that even though I might not know their Latin name or their proper name that they all belong—You know the wattles in particular just by the little yellow flower. That there are different wattles within.	<b>K3</b>
<b>R:</b> Yeah, yeah.	
<b>Teacher:</b> So I think that's been the biggest learning for me. So yeah. I think I'm able to identify quite a lot of the plants now.	<b>Explains improvement in K</b>
<b>R:</b> How do you feel about plants in general?	
<b>Teacher:</b> Well I love plants. Always have loved plants. My family, they get quite annoyed with me when we go on our bush walks because I'm always stopping. "Hurry up Mom. Hurry up Mom." Because I'm taking photos of something that's flowering or something I haven't seen before. So yes. I do very much enjoy the plants.	<b>B4</b>

Table 4 displays three children's drawings and verbal descriptions from the first visit on what they knew about plants with drawings and verbal descriptions from the last visit on what they knew about plants. The detail in the drawings of each child demonstrated a deeper understanding of plants at the end of the year. Levi for example, has explained knowledge that came from the Maarman about surviving without food and water and looking for green reeds for sustenance. Raffy has developed his knowledge from being able to name some familiar fruit to understanding the

life cycle of a plant, including that carnivorous plants can consume insects for food. These children were initially coded as having nominal botanical literacies and at the end of the year, they were demonstrating relational and multi-dimensional levels of botanical literacies.

Table 4. *Bush Hills Primary School Children's Drawings and Descriptions.*

Drawings from first visit- What do you know about plants?	Drawings from last visit- What do you know about plants?
 <p>Plants make fruit- Raffy K1</p>	 <p>"This is a seed, then a stem, then a leaf on both sides. Then a flower and then the plant dies. Then the seeds make lots more plants. Plants need food and nutrients. For food, some plants eat flies and insects. Plants give love, they are beautiful." Raffy- (December) K3, U4, B4</p>
 <p>Golden Honey Flowers- Maddie K1</p>	 <p>"This is a climbing sundew and the bug is coming so the plant can eat it." (n.b. the sundew is a carnivorous plant) Maddie K4</p>
 <p>Levi K1</p>	 <p>"What I know about plants 1.1.12.2020 if you see green reeds pull it out and if there is a white bit at the end you can eat it. if birds are chirping if you see red it normally means danger so turn around when you see RED DANGER</p> <p>"If you see green reeds, pull it out and if there is a white bit at the end, you can eat it. If you see red, it normally means danger, so turn around when you see red." Levi U4</p>

## Findings

This section presents the data that addresses the research question “What impact does the inclusion of Indigenous Knowledges have on the botanical literacies of children and teachers in ECE?” The data are then analysed to examine the levels of botanical literacies for ECE developed by Beasley et. al. in 2021.

### ***Maarman’s Visit***

Maarman held the two classes entranced for over an hour with his pedagogy of story-telling and hands-on demonstrations before walking through the bush space with the children for another hour. The stories for each plant spanned time with examples from before colonisation, stories during colonisation as well as current uses of the plants. Hands-on and visual examples were provided for the uses of some of the plants. To respect the stories told by Maarman about each plant, and with his permission, the research findings will reflect some of the plants discussed by Maarman and the stories communicated, as well as the changes in the children’s and teachers understandings, attitudes and behaviours about the following native plants.

### ***Balga***

Maarman explained that to the Noongar people (the language group to which he belongs), the *Balga* (Grass Tree) is the most important plant for supporting human life. It provides water, shelter, fire, and medicine that cures bites from venomous snakes. Maarman demonstrated how to take the fronds from the plant to suck the inner white ends to find water if water was unavailable elsewhere. He also used his own fire sticks made from the *Balga* flower stem to demonstrate to the children how fire has been made by Noongar people for tens of thousands of years. Maarman also explained that *Balga* trees are slow growing and most of the plants in the school’s bush spaces were over 100 years old. In explaining this, he said that in extreme emergencies, if a person was bitten by a poisonous snake, the centre of the *Balga* plant has a white mixture that can be used as a medicine to heal the person, but this use of the medicine would also kill the plant. After the visit, the children from Bush Hills Primary School initiated a retelling of the story of the *Balga* and its uses to each other during their self-initiated and self-directed dramatic play. They made shelters under the bigger *Balgas* in their playspace. There were some children who wanted to pick a leaf frond to taste it for the water at the base, but other children were quick to explain that the plants should only be used when no water is available and reminded peers to look after the plants.

### ***Marri***

The *Marri* (Red Gum) trees in the bush space of Bush Hills Primary School were very large and there were many of them. During the first two visits of the school year, the *Marri* trees were in flower and the children referred to these as ‘honey trees’ due to the strong smell of the flowers. Later in the year the trees produced large gumnuts, locally referred to as ‘Honkey Nuts’. The children used these in their play as counters and had also noticed the local native Black Cockatoos like to eat the nuts. Maarman told the children about the medicinal uses of the *Marri* sap, one of the uses was applying it to the skin as a remedy for eczema. One of the children in the class suffered from Eczema and every visit to the bush after Maarman’s visit, he would go to the tree, take sap from the tree with a stick and apply it on to his eczema. During the last visit to the school, the child proudly showed the lead researcher that his eczema had disappeared and he explained the “*Marri* sap made it go away”.

### ***Djop Born***

In Banksia Beach Primary School, there were many *Djop Born* (Soap Bush) plants in the bush space. Maarman put some water in a cup, rubbed the leaves of the soap bush plant in his hands with water and the water foamed, like soap. He explained soap bush was used by Noongar people to wash themselves and the animal skins that were worn as clothes. Following Maarman’s visit, this class regularly would make soap from the plant as part of their play and demonstrated to other children in the school how to do this.

### ***Biara***

Banksia Beach Primary School had mostly *Biara* (Banksia) scrubland for their bush space. At the beginning of the year, the teacher and children commented that the Banksia trees looked dead. They were blackish and drooping with no visible flowers. There were lots of black Banksia pods on the plants and scattered on the ground. The children used them as a part of their play and would collect them into piles which would be 'owned' by different groups of children in a kind of competition to see who could collect the most. During Maarman's visit, he explained that the Banksia pod was vital for carrying fire from camp to camp during the winter and through the rain. Noongar women would carry these Banksia pods in a bag and carry fire on one of them, transferring the fire to another seed pod as each one burned out. This way the Noongar people would not need to relight a fire every time they made a new camp.

During the children's investigations about the Banksia, they also learned that Banksias need fire to open the follicles and release the seeds, in this way, the Noongar people were also helping to propagate the seeds of Banksia as they travelled. The children were interested to replicate this and see the follicles open for themselves, so together with the researcher and the teachers, the children baked some Banksia seed pods in a conventional oven at a high temperature to release the seeds as fire would. This was somewhat successful as some of the follicles opened and the children were able to see the seeds from inside. Maarman also explained that the flowers of the Banksia can be mixed in water to make a cordial drink during the warmer months. The children were also eager to try this once the flowers were at the right stage, but this did not occur during the data collection period.

### ***Wanil***

The *Wanil*, (Weeping Peppermint) tree was found in the bush space of Bush Hills Primary School. Maarman took some leaves and rubbed them between his hands, crushing the leaves to release a strong peppermint smell. He explained to the children this is good for smelling and rubbing of your chest when you have a cough. He also explained it is good for cooking with fish for extra flavour and can also be tied in a certain noose and used to attract and catch Marron (a local freshwater crayfish). The children were observed pretending to use plants to catch Marron and fish in a subsequent visit based on this advice. Some children had also explained they advised their parents to cook fish with the Wanil leaves for extra flavour.

### **Analysis of Botanical Literacies as a result of Maarman's visit**

Considering the levels of botanical literacies in ECE listed above (Beasley et. al., 2021), there are three criteria that are observed in the highest level of botanical literacy, the multi-dimensional level:

- a. Children can explain plants are a part of a larger, interconnected ecosystem;
- b. Children are curious and intrinsically motivated to understand plants and botany; and
- c. Children make ethical decisions relating to plants.

The narratives above demonstrate children meeting all three of these criteria. Before Maarman's visit, the botanical learning in the bush space had been based on the children's inquiry-based questions and had been about naming, identifying the plants and observing the changes in the plants through the seasons. Their plant understanding had developed, but they had not clearly demonstrated an understanding of interconnectedness until Maarman's visit. Through his powerful and engaging stories, Maarman introduced the children to traditional uses of the plants, and this changed the way the children interacted with the plants during their bush visits. They were more hands-on with the plants, touching, taking sap, making soap, crushing and smelling. Their conversations shifted from what a plant's name is, when it flowers and what it looks like, to how it is connected to people and how it is useful. These demonstrated that children understood that plants are part of an interconnected system and humans rely on plants for food, fire, shelter, and medicine. Some examples of the children's comments about plants after Maarman's visit were:

*"Green reeds only grow where there's fresh water. If you're in the bush and you're lost, if you find a green reed and you're very thirsty then you can use the reeds to find water."* (Ruby, aged 8 years)

*“They (Banksias) start off as that and then they grow into the furry things and then they grow into the green stalk. Then eventually they flower and then they die and turn into brown things. Then when it’s hot enough, the seeds will pop out. They can be carried for fire.....Banksias are so special”*  
 (Evie, aged 8 years)

Before Maarman’s visit, the children’s curiosity was about the variety of plants and why and how they grow, and they were motivated to observe the changes in the plants physically. After Maarman’s visit the children were curious about the uses of the plants and they were motivated to interact with the plants and ‘try out’ what they learned from Maarman. Figures 3 and 4 show the changes in the children’s botanical literacy behaviours, including curiosity, after visit 14, which was Maarman’s visit. The codes on the vertical axis are displayed in Table 2.

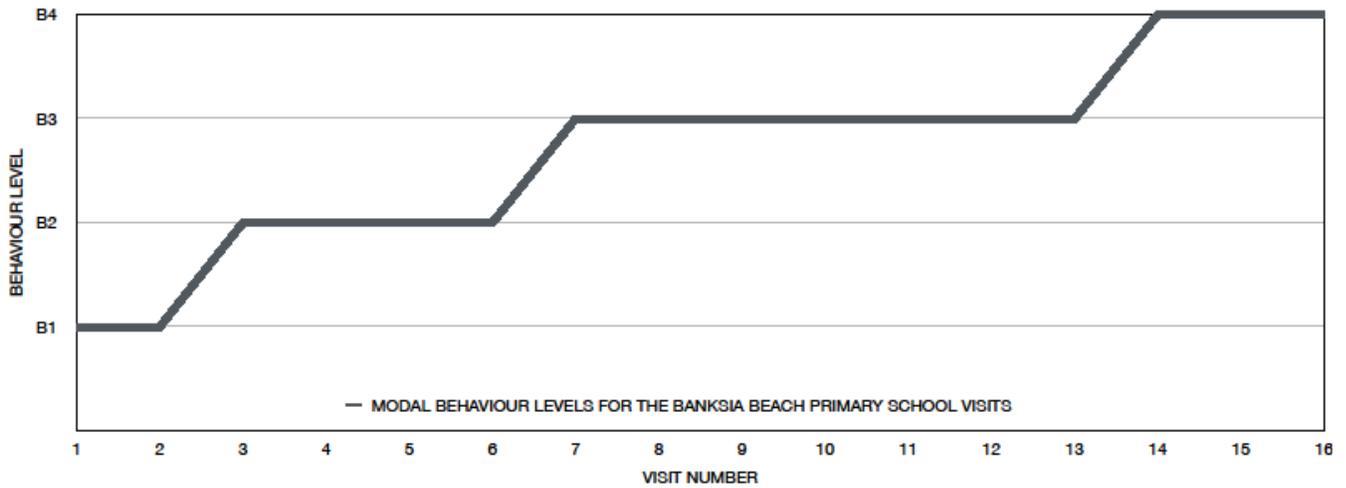


Figure 3. Changes in Botanical Literacy Behaviour in Children from Banksia Beach Primary School over 16 visits

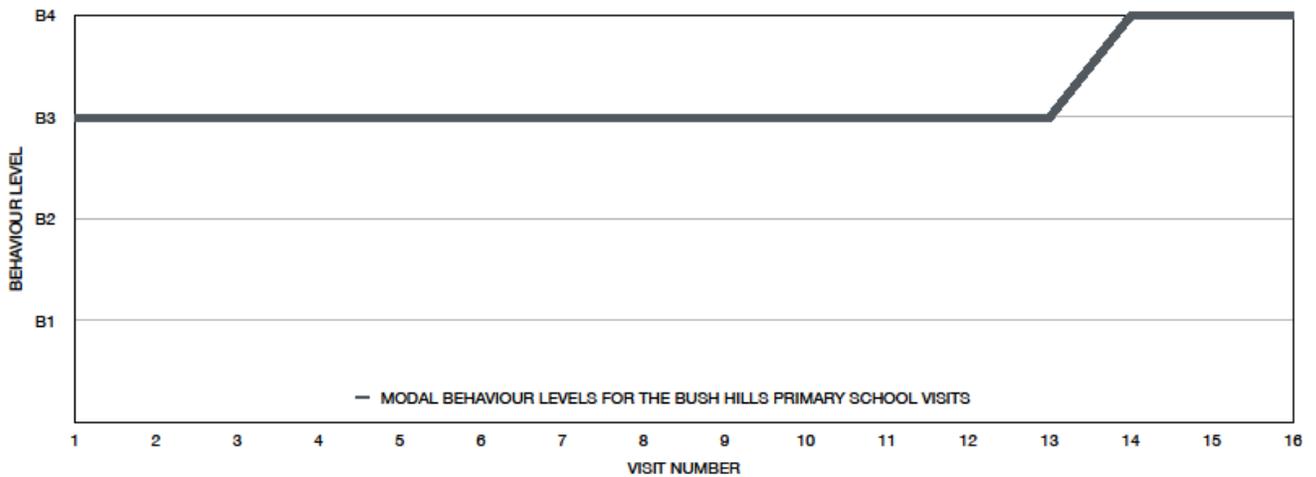


Figure 4. Changes in Botanical Literacy Behaviour in Children from Bush Hills Primary School over 16 visits

In terms of the third criteria for the multi-dimensional level of botanical literacies, it was not as clear that the children were making more ethical decisions relating to the plants. Before the visit, the researcher and teachers had discussed

with the children about not touching the plants and only looking, as they are living things and we must care for them. After Maarman's visit, the teachers were nervous the children were utilising the plants too heavily for their play and exploration so we had conversations with the children reminding them of Maarman telling the class to 'only take what you need'. Some children understood this immediately and told other children not to pick the plants. A balance was needed between the children being able to have a turn and explore the uses of the plants and making ethical decisions around their use. This balance of using the plants, whilst also caring for them is an important concept connected to cultural practices and sustainability. The teachers introduced the plants to the children as something only for looking at and instructed the children only to use parts of the plants that had fallen to the ground. The Traditional Owner instructed the children to touch, smell, pick and use if required. Through observation and guided participation by adults from different cultural backgrounds, the children are learning that different people have different cultural practices or '*constellations of cultural practices*' a term used by Rogoff (2018) to describe their use of plants.

### Discussion

It has been cited in previous research that inviting an Indigenous Elder to participate in an ECE program to speak on one topic could be seen as tokenistic or providing fragmented cultural practices rather than embedding Indigenous Knowledge systems (Miller, 2015). The narrow topic of this current study of botanical knowledges lends itself to the possibility of filling the researcher's 'need' in the curriculum for an Indigenous perspective. An Indigenous Elder was sought for the specific purpose of sharing their knowledge of the local native plants in the bush space. However, we believe that because this knowledge was shared as a part of a year-long study on botanical literacies and in the bush space with the children. The Indigenous Knowledge enriched the curriculum, the teachers' and children's knowledge and had a strong impact on the way the children and their teachers interacted with the plants in the bush after Maarman's visit. The Indigenous Knowledge provided new ways for the children to interact with the plants and new understandings about the history and importance of the plants in their local environment. These new understandings developed from the Elder's visit clearly supported botanical literacies to be attained at the highest level of multi-dimensional botanical literacies, whereby the children were able to explain that plants are part of a larger, interconnected eco-system (Beasley et. al., 2021).

It is important to note that the pedagogies used by Maarman during his two visits contrasted the pedagogies used by the researcher and teachers during the other fieldwork visits. During the researcher's visits, the botanical practices included observing plants, drawing, mapping and identifying plants and flowers. It became obvious during the analysis that the researcher's pedagogy of inquiry and the botanical practices used were aligned with Western systems of knowledge, stemming from settler colonial contexts which placed the humans as separate from the plants (Ritchie, 2017). In contrast, Indigenous pedagogies used by Maarman which included storytelling and hands-on experiences, demonstrated to the children that humans are inextricably intertwined with nature (Pacini-Ketchabaw, 2013). This contrast in cultural practices is reflective of the multi-cultural Australian context. Rogoff (2018) suggests that instead of trying to dissect cultural contexts into separate factors, we view the context as a *constellation of cultural practices*. The context in Australia, is that children are living and learning on unceded Aboriginal land, which has a complex history. Teaching practices infused in educational environments need to reflect this context.

### Conclusion

The inclusion of Indigenous Knowledges from a Noongar Elder in this study on young children's botanical literacies demonstrated that Indigenous Knowledges can strongly support children to develop the highest level of botanical literacies. The authentic stories and hands-on, engaging pedagogies of the Elder awakened the children and teachers to the interconnectedness of humans and nature.

Indigenous Knowledges are shared and relied on that specific Country and hence the learning is local; it is produced in context, time and place. Thus, the specific learning from the children and teachers in this study cannot be replicated across other schools. What can be replicated, is the authentic invitation for an Indigenous person to share their knowledge and perspectives with the children on specific topics that are relevant to the curriculum at the time of the visit. This study showed it was beneficial for the children to already have a strong foundational knowledge of

plants, so the learning was relevant and meaningful. As the children and teachers had prior knowledge and lived experience with specific plants in a unique bush space, they were able to make authentic connections between themselves, the environment and Indigenous Knowledges.

In this study, the children's and teachers' prior knowledge of plants was evaluated through the Framework for Developing Botanical Literacies (Beasley et. al., 2021), which placed the classes in the bush spaces once a fortnight for the duration of the school year and included regular time in nature, hands-on, sensory exploration and inquiry as well as having a 'botanically interested' and passionate adult with the students as essential practices for developing botanical literacies. These practices, in addition to including authentic Indigenous Knowledges can hopefully be replicated in any early childhood setting.

This research study also opened new possibilities for bridging the gap between Western systems of thinking around botany and Indigenous pedagogies. The study set out to research the impact of including Indigenous perspectives when teaching botanical literacies. We found the infusion of Indigenous Knowledges in botany and ECE teaching using the Mosaic Approach to be effective for increasing plant knowledge and understanding, but in analysing our practise, we also realised that colonial epistemologies are embedded in traditional botanical practices, including naming plants, mapping native bushland and seeing plants as a human resource. This reflects what has been found to occur in Australian classrooms (Somerville et al., 2019) and implores nature-based researchers and teachers to explore new methods to entangle and infuse their pedagogies with Indigenous ways of knowing, being and doing (Jackson-Barrett et al., 2019; Johnston, 2020; Martin & Mirraboopa, 2003; Martin, 2017) on Country, not just looking at and studying plants and nature as separate from humans.

## References

- Australian Bureau of Statistics. (2016). Estimates of Aboriginal and Torres Strait Islander People. <https://www.abs.gov.au/statistics/people/aboriginal-and-torres-strait-islander-peoples/estimates-aboriginal-and-torres-strait-islander-australians/jun-2016>
- Australian Curriculum and Reporting Authority. (2019). *Australian Curriculum*. ACARA. <https://www.australiancurriculum.edu.au/resources/>
- Beasley, K.D, Lee-Hammond, L., & Hesterman, S. (2021). A Framework for Supporting the Development of Botanical Literacies in Early Childhood Education. *International Journal of Early Childhood*, 1-19. <https://doi.org/10.1007/s13158-021-00291-x>
- Bellard, C., Leclerc, C., Leroy, B., Bakkenes, M., Veloz, S., Thuiller, W., & Courchamp, F. (2014). Vulnerability of biodiversity hotspots to global change. *Global ecology and biogeography*, 23(12), 1376-1386. <https://doi.org/10.1111/geb.12228>
- Bradshaw, C. J. A. (2012). Little left to lose: deforestation and forest degradation in Australia since European colonization. *Journal of Plant Ecology*, 5(1), 109-120. <https://doi.org/10.1093/jpe/rtr038>
- Clark, A. (2011). Breaking methodological boundaries? Exploring visual, participatory methods with adults and young children. *European Early Childhood Education Research Journal*, 19(3), 321-330. <https://doi.org/10.1080/1350293X.2011.597964>
- Clark, A. a. (2017). *Listening to young children : a guide to understanding and using the mosaic approach* (Expanded third edition.. ed.). Philadelphia : Jessica Kingsley Publishers.
- Cochrane, J. A., Barrett, S., Monks, L., & Dillon, R. (2010). Partnering conservation actions. Inter situ solutions to recover threatened species in South West Western Australia. *Kew bulletin*, 65(4), 655-662. <https://doi.org/10.1007/s12225-010-9233-0>
- Corsiglia, J., & Snively, G. (2001). Rejoinder: Infusing indigenous science into western modern science for a sustainable future. *Science education (Salem, Mass.)*, 85(1), 82-86. [https://doi.org/10.1002/1098-237X\(200101\)85:1<82::AID-SCE11>3.0.CO;2-Q](https://doi.org/10.1002/1098-237X(200101)85:1<82::AID-SCE11>3.0.CO;2-Q)
- Creswell, J. (2014). *Educational research: planning, conducting, and evaluating quantitative and qualitative research* (Fourth, Pearson new international ed.). Pearson. <https://go.exlibris.link/mLz2gg0w>
- Department of Education and Training. (2019). *Belonging, being and becoming; The early years learning framework For Australia*.

[https://docs.education.gov.au/system/files/doc/other/belonging\\_being\\_and\\_becoming\\_the\\_early\\_years\\_learning\\_framework\\_for\\_australia\\_0.pdf](https://docs.education.gov.au/system/files/doc/other/belonging_being_and_becoming_the_early_years_learning_framework_for_australia_0.pdf)

- Edwards, C. P., Gandini, L., & Forman, G. E. (2012). *The hundred languages of children: the Reggio Emilia experience in transformation* (3rd ed.). Praeger.
- Elliott, S., & Chancellor, B. (2014). From forest preschool to bush kinder: An inspirational approach to preschool provision in Australia. *Australasian Journal of Early Childhood*, 39(4), 45-53.  
<https://doi.org/10.1177/183693911403900407>
- Elliott, S., & Davis, J. (2009). Exploring the resistance: An Australian perspective on educating for sustainability in early childhood. *International Journal of Early Childhood*, 41(2), 65-77.  
<https://doi.org/10.1007/BF03168879>
- Grace, R., & Trudgett, M. (2012). It's not rocket science : the perspectives of Indigenous early childhood workers on supporting the engagement of Indigenous families in early childhood settings. *Australasian Journal of Early Childhood*, 37(2), 10-18. <https://doi.org/10.1177/183693911203700203>
- Hansen, V., & Horsfall, J. (2016). *Noongar bush medicine: Medicinal plants of the south-west of Western Australia*. UWA Publishing.
- Hesterman, S. (2013). Early childhood designs for multiliteracies learning. *The Australian journal of language and literacy*, 36(3), 158-168.
- Jackson-Barrett, E., Lee-Hammond, L., & Murdoch, U. (2019). From Pink Floyd to Pink Hill : Transforming Education From the Bricks in the Wall to the Connections of Country in Remote Aboriginal education. *The Australian Journal of Teacher Education*, 44(10), 35-51. <https://doi.org/10.14221/ajte.2019v44n10.3>
- Jackson-Barrett, E. M., & Lee-Hammond, L. (2018). Strengthening identities and involvement of Aboriginal children through learning on country. *Australian Journal of Teacher Education (Online)*, 43(6), 86-104.  
<https://doi.org/10.14221/ajte.2018v43n6.6>
- Johnston, M. a. (2020). *Working two way : stories about cross-cultural collaboration from Noongar country / Michelle Johnston, Simon Forrest*. Singapore : Springer Nature Singapore.
- Jones, R., Thurber, K. A., Wright, A., Chapman, J., Donohoe, P., Davis, V., & Lovett, R. (2018). Associations between participation in a ranger program and health and wellbeing outcomes among aboriginal and torres strait islander people in central Australia: A proof of concept study. *Int J Environ Res Public Health*, 15(7), 1478.  
<https://doi.org/10.3390/ijerph15071478>
- Kimmerer, R. W. (2013). *Braiding sweetgrass* (First ed.). Milkweed Editions.
- Kinzel, C. (2020). Indigenous Knowledge in Early Childhood Education: Building a Nest for Reconciliation. *Journal of Childhood Studies (Prospect Bay)*, 45(1), 19-32. <https://doi.org/10.18357/jcs00019397>
- Martin, K., & Mirraboopa, B. (2003). Ways of knowing, being and doing: A theoretical framework and methods for indigenous and indigenist re-search. *Journal of Australian studies*, 27(76), 203-214.  
<https://doi.org/10.1080/14443050309387838>
- Martin, K. L. (2017). It's special and it's specific: understanding the early childhood education experiences and expectations of young Indigenous Australian children and their parents. *Australian Educational Researcher*, 44(1), 89-105. <https://doi.org/10.1007/s13384-017-0231-1>
- Merritt, E., Peterson, A., Evans, S., Marston, S. A., & Zuiker, S. (2021, 2021 March-April). Learning About Culture and Sustainable Harvesting of Native Plants: Garden-based teaching can foster appreciation of indigenous knowledge. *Science and Children*, 58(4), 69+.
- Miller, M. G. (2015). Consultation with Aboriginal and Torres Strait Islander people in early childhood education: the impact of colonial discourses. *Australian Educational Researcher*, 42(5), 549-565.  
<https://doi.org/http://dx.doi.org/10.1007/s13384-015-0186-z>
- Murdoch, K. (2015). Beyond topics : what's worth inquiring into? In *The Power of Inquiry : teaching and learning with curiosity, creativity and purpose in the contemporary classroom*.
- Otto, S., & Pensini, P. (2017). Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. *Global environmental change*, 47, 88-94. <https://doi.org/10.1016/j.gloenvcha.2017.09.009>
- Pacini-Ketchabaw, V. (2013). Frictions in Forest Pedagogies: Common Worlds in Settler Colonial Spaces. *Global Studies of Childhood*, 3(4), 355-365. <https://doi.org/10.2304/gsch.2013.3.4.355>
- Rinaldi, C. (2006). *In dialogue with Reggio Emilia: listening, researching and learning*. Routledge.  
<https://go.exlibris.link/z64q1Hr2>

- Ritchie, J. (2017). Fostering Eco-Cultural Literacies for Social, Cultural and Ecological Justice: A Perspective From Aotearoa (New Zealand). *International Journal of Early Childhood*, 49(3), 287-302. <https://doi.org/10.1007/s13158-017-0198-0>
- Rowan, M. C. (2017). Rethinking relationships with curriculum by engaging with foxes and sharing stories in early childhood spaces. *Global Studies of Childhood*, 7(2), 131-147. <https://doi.org/10.1177/2043610617703833>
- Sammel, A., & Whatman, S. (2018). A novel approach to developing literacies in Indigenous knowledge systems and western science knowledge: Lessons from primary school students in Australia. *Journal of Australian Indigenous Issues*, 21(1-2), 40-60.
- Sivak, L., Westhead, S., Richards, E., Atkinson, S., Richards, J., Dare, H., Zuckermann, G. a., Gee, G., Wright, M., Rosen, A., Walsh, M., Brown, N., & Brown, A. (2019). "Language Breathes Life"-Barngarla Community Perspectives on the Wellbeing Impacts of Reclaiming a Dormant Australian Aboriginal Language. *International journal of environmental research and public health*, 16(20), 3918. <https://doi.org/10.3390/ijerph16203918>
- Somerville, M., Powell, S., & Trist, N. (2019). Being-Country in Urban Places: Naming the World Through Australian Aboriginal Pedagogies. *Journal of childhood studies (Prospect Bay)*, 44(4), 98-111. <https://doi.org/10.18357/jcs444201919215>
- Taylor, A. (2013). Caterpillar childhoods: Engaging the otherwise worlds of central Australian Aboriginal children. *Global Studies of Childhood*, 3(4), 366-379. <https://doi.org/10.2304/gsch.2013.3.4.366>
- Tsing, A. L. (2005). *Friction: an ethnography of global connection*. Princeton University Press.
- United Nations. (2007). *United Nations Declaration on the Rights of Indigenous Peoples*. United Nations. <https://humanrights.gov.au/our-work/un-declaration-rights-indigenous-peoples-1>
- Whatman, S., Quennerstedt, M., & McLaughlin, J. (2017). Indigenous knowledges as a way to disrupt norms in physical education teacher education. *Asia-Pacific journal of health, sport and physical education*, 8(2), 115-131. <https://doi.org/10.1080/18377122.2017.1315950>
- Whitehouse, H., Watkin Lui, F., Sellwood, J., Barrett, M. J., & Chigeza, P. (2014). Sea Country: navigating Indigenous and colonial ontologies in Australian environmental education. *Environmental Education Research*, 20(1), 56-69. <https://doi.org/10.1080/13504622.2013.852655>
- Willig, C. e., & Stainton Rogers, W. e. (2017). *The SAGE handbook of qualitative research in psychology* (2nd ed.). SAGE Publications.
- Yin, R. (2014). *Case study research: Design and methods*. Sage Inc.

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