Author/s:
Young, S;Eadie, T;Suda, L;Church, A

Title:
LEARN: Essential Elements of Museum Education Programs for Young Children

Date:
2022-01-01

Citation:
Young, S., Eadie, T., Suda, L. & Church, A. (2022). LEARN: Essential Elements of Museum Education Programs for Young Children. Curator, 65 (1), pp.209-223. https://doi.org/10.1111/cura.12456.

Title page for article **21-01-CUR-OA-010.R2**

#Please create a separate title page containing-title of the manuscript, running title of the manuscript, authors' names and affiliations, corresponding author email address, acknowledgements(if any), funding information(if any), short author biography of not more than 50 words(1-3 lines) for all authors.

Title: LEARN: Essential elements of museum education programs for young children.

Running title: Education programs for children

Acknowledgements: We acknowledge Wurundjeri peoples as Traditional Owners and Custodians of the land where this research took place.

Funding: This project was funded by a McCoy Seed Funding Scheme, a grant that supports the development of collaborative research projects between Museums Victoria and the University of Melbourne.

Authors:

Professor Tricia Eadie, Melbourne Graduate School of Education, The University of Melbourne.

Dr Sarah Young, Melbourne Graduate School of Education, The University of Melbourne.

Ms Liz Suda, Museum Victoria.

Dr Amelia Church, Melbourne Graduate School of Education, The University of Melbourne.

Tricia Eadie is the Director of the Research in Effective Education in Early Childhood Education (REEaCh Hub) at the University of Melbourne, which has research priorities of quality, equity and leadership in early childhood education. Sarah Young is a Lecturer in the Melbourne Graduate School of Education, with expertise in pedagogy and play. Liz Suda is the Education Program Coordinator for Museum Victoria, and Amelia Church is an Senior Research Fellow at the REEaCh Hub in the Melbourne Graduate School of Education.

Drag	1 2 3 4	Select... Edit Assign as Corresponding Author _____ Remove Author	**Young, Sarah** sry@unimelb.edu.au	1. The University of Melbourne, Melbourne Graduate School of Education Melbourne, VIC, AUS
Drag	1 2 3 4	Select... Edit Assign as Corresponding Author	**Eadie, Patricia** peadie@unimelb.edu.au	1. The University of Melbourne, Melbourne Graduate School of Education Melbourne, VIC, AUS

		_____ _____ Remove Author		
Drag	1 2 3 4	Select... Edit Assign as Corresponding Author _____ _____ Remove Author	**Suda, Liz** esuda@museum.vic.gov.au	1. Melbourne Museum Melbourne, VIC, AUS
Drag	1 2 3 4	Select... Edit _____ _____ Remove Author	**CHURCH, AMELIA (Corresponding Author)** achurch@unimelb.edu.au 0000-0002-2013-4888 ✓	1. The University of Melbourne, Melbourne Graduate School of Education Melbourne, VIC, AUS

DR. AMELIA CHURCH (Orcid ID : 0000-0002-2013-4888)

Article type : Original Article

LEARN at the museum: Essential elements of education programs for young children

Abstract

Museums provide rich multimodal learning opportunities and long-lasting memories for children and teachers who participate in museum excursions and outreach programs. Museum programs for preschool children embed hands-on opportunities to engage children with new and diverse artefacts. Interactions in museum settings provide opportunities for adults and children to collaborate in learning. Our aim in this project was to explore the elements of museum programs that prove essential in engaging young children in museum education programs.

Five museum presenters and 14 early childhood groups (14 teachers and 296 children) participated in the research project. Data collection included audio recordings of museum presentations, observations of child-teacher interactions, multiliteracy observations, teacher interviews, and written reflections from the museum presenters. Coding across all datasets contributed to the five main themes in the findings, which we detail using the acronym LEARN:

Learning artefacts; **E**mbodied teaching and learning; **A**sking questions; **R**epetition: and **N**arrative.

Multiple elements of museum education programs influence learning opportunities for young children. Both structural elements (e.g. designing a core narrative around concepts, or time for children's individual queries during the program and hands-on explorations with museum artefacts) and learning interactions (e.g. conversations where children and adults collaborate) contribute to engaging museum education programs for young children.

Museums are places of learning

Museum experiences have the potential to make a significant impact on young children's learning. Research has demonstrated that children have long-lasting, durable and detailed recollections of their visits, remembering physical aspects, such as artefacts, as well as concepts (Falk & Dierking, 2016; Munley, 2012). These recollections and the learning that corresponds with them are influenced by personal, physical and social contexts, and connected to events that occur before and after the visit (Falk & Dierking, 2016; Hooper-Greenhill & Moussouri, 2006). The experiential learning that takes place in children's museum programs, occurs through exploration and allows for deep engagement and discovery (Brown, Jeanneret & Andersen, 2019; Piscitelli & Penfold, 2015). In addition, the interactions between children and curators and teachers, between children and technology, and between children and the physical learning space, are central to learning experiences (Andre, Durksen & Volman, 2017).

Young children learn through play as they use their senses to engage with objects, places and people using multiple modes of representation (Cope & Kalantzis, 2000), and museums make use of these elements in an experiential model of learning (Piscitelli & Penfold, 2015). Museum programs for preschool children embed hands-on opportunities to engage the children with novel and diverse artefacts (Lee, 2020, Piscitelli & Anderson, 2007). While artefacts may be enticing for children, in isolation these objects do not necessarily link to learning or understandings of the artefacts' context (Jant, Haden, Uttal, & Babcock, 2014; Wolf & Wood,

2015). The conceptualisation of artefacts is made visible by focused interactions with children, teachers, parents and museum presenters. When museum programs include children's manipulation of the objects, and museum presenters' learning conversations about the objects, the artefacts come into being (Piscitelli, & Anderson, 2007). These physical and verbal interactions have the potential to elicit children's and adults' individual and shared ideas about, and significance of, the cultural artefacts and broader concepts.

Learning interactions at the museum

High-quality interactions that occur in museum settings provide opportunities for adults to scaffold children's learning. In this process, adults provide supports to children that enable them to express ideas verbally, assisting them to gain new understandings, investigate the world around them and develop collaborative learning skills (Piscitelli, 2012). The quality of adult interactions affects the complexity of children's learning (Clarkin-Phillips, Carr, Thomas, Tinning & Waitai, 2018; Munley, 2012) and relies on the presenters' use of open-ended questions and contingent responses to children's contributions (Pianta et al., 2008). Research has found that the use of open-ended questions to support critical thinking helps "connect to children's engagement in exhibits and memory for exhibit information" (Callanan, Castañeda, Luce, & Martin, 2017, p. 1493).

Essentially, "adults can help children respond to works of art by extending the conversation and helping them build knowledge of artistic concepts, new vocabulary and the context of an object" (Lifschitz-Grant, 2018, p. 260). That is, the interactions that respond to children's focus of inquiry, extend that inquiry, and introduce new depth of thinking about the local environment (Tayler, Ishimine, Cloney, Cleveland &Thorpe, 2013). High quality early childhood education is distinguished by immersive experiences where adult-child interactions are sustained, responsive and provide rich language and literacy content (Church & Bateman, 2022; Pianta, 2012; Pianta, La Paro & Hamre, 2008). Museum programs have the potential to provide such content (Piscitelli & Weier, 2002) but there is a lack of research that details children's

interactions within these programs (Black, 2012; Piscitelli & Anderson, 2001), particularly the integration of Science and Humanities content within them (Munley, 2012).

Elements of museum programs that support children's learning

Research shows us that museum programs encourage young children's participation through public perception of the space as local, safe and accessible (Sirinides, Fink & DuBois, 2017), and collections that support early and ongoing learning (Foreman-Peck & Travers, 2013). To encourage children's participation, most museums offer education programs, at no cost or a small fee, designed to introduce collections to children and enable them to explore concepts and properties of museum exhibitions (Andre, Durksen & Volman, 2017). Museum programs are led by museum presenters/curators who guide the learning focus as they interact with children and teachers acquainting them to the museum artefacts and displays (Andre, Durksen & Volman, 2017). With young children, this is a collaborative environment where children have time to engage with peers and adults as part of the experience (Piscitelli & Penfold, 2015). Piscitelli & Anderson (2007) documented children's perspectives on museum programs, highlighting that museum presenters/curators need to make visible the links to children's prior understandings to contextualise the current learning. Existing research has demonstrated the value of learning experiences at museums. The distinct contribution of this paper is to bring expertise in early childhood education to investigate how education programs are delivered in early learning contexts. Our aim in this paper is to explore the elements of museum programs that prove essential in supporting learning opportunities for young children.

Method

This study is based on two early childhood education programs designed and delivered by an inner-city museum in Australia. Both programs in this study were implemented by museum presenters with preschool children – 4 and 5-year-olds in their year prior to formal schooling – and their teachers. Program A was based at the museum whereas Program B was conducted in preschool settings. Not all museums are able to offer this type of outreach program, but

outreach programs enable access for those who are unable to visit the museum and to inspire future engagement with museums. The research project involved five museum presenters and 14 early childhood groups (14 teachers and 296 children). Museum presenters, early childhood teachers and parents provided informed consent to audio record and have two researchers observe the presentations which lasted for approximately thirty minutes at the museum (Program A; seven early childhood groups) and approximately 45 minutes for the outreach visits to early childhood centres (Program B; seven early childhood groups). The aim of the project as a whole was to document how outreach and museum-based programs for young children supported concept, language and literacy learning, and how this learning is embedded in subsequent preschool curriculum. The aim of this paper is to detail elements of the program that supported children's learning.

Program A was a relatively new education program hosted at the museum and focused on introducing museum artefacts to explore concepts of place, Australia's Indigenous culture, and environment. To begin, children sat with the presenter as they introduced a story focused on two children and the artefacts found in an imaginary granddad's shed, on the Murray River, which included shears, taxidermy beetles in perspex, rocks, a taxidermy possum and Indigenous artefacts of clapping sticks, boomerang and a possum skin pelt (see Atkinson, 2017).[1] After talking about the artefacts, the children were invited to spend a short time in small groups at tables to engage in a task related to five of the objects from the story (see examples in Figure 1). Each table had a different task with a focus on either feathers, rocks, beetles, boomerangs and clapping stick markings, or a possum skin pelt; the museum presenter timed these interactions so that the groups had several minutes at each table. The early childhood teachers

[1] In Australia, "A possum skin was an Aboriginal child's first blanket. The underside of the skin was incised using a shell or stone with symbols that were significant to the clan group and connected the child spiritually to the land and the spirit ancestors. Over time, pelts and symbols would be added so that the skin would grow with the child" (Atkinson, 2017, p. 5).

and parents accompanied the groups of children as they handled and discussed the artefacts at each table.

[insert Figure 1 here]

Figure 1: Early learning programs at the museum. *Source: Museums Victoria / Photographer : Rodney Start.*

Program B was an outreach provision to childhood centres with an education program focusing on dinosaurs and fossils; this program had been running for several years. There were three parts to the museum program. Firstly, the museum presenter introduced themselves to the children and explained that they would all be palaeontologists together and embark on scientific discovery. Secondly, the presenter involved children in an interactive story with related artefacts about how dinosaurs lived, died and the process of fossilisation. Finally, the children had the opportunity to handle and talk about the bones and fossils the museum presenter had introduced during the story.

Methods of data collection for both Programs included pre-surveys and post-interviews with teachers, audio recordings of presentations, observations of child-teacher interactions, multiliteracy observations and written reflections from museum presenters. The Classroom Assessment Scoring System (CLASS; Pianta, La Paro & Hamre, 2008) was used to observe teacher-child interactions. CLASS is a standardised instrument of the quality of interactions in early childhood settings. Trained observers in this project focussed on interactions in the domain of instructional support (representing concept development, quality of feedback, and language modelling) to detail the practices used by museum presenters in both programs. CLASS observations of the instructional support were augmented by a second research assistant recording multiliteracy observations. This method is based on the five modes of meaning defined by Cope and Kalantzis (2000) which are combined, deployed or integrated in various ways to build a multimodal system for creating meaning (see Cope & Kalantzis, 2000, p.26). These modes include linguistic, audio, spatial, gestural and visual design, and during the

observation, the researcher noted resources used by the presenter to establish meaning with the children, as indicative of one of these five modes of multiliteracy.

An iterative analysis of these two sets of observational data generated codes for the data from both Program A and Program B. Internal validity for these codes was established by blind review by a second analyst and evidence to support these codes was provided in the teacher and museum presenter reflections. Multiple codes were identified, and only those that appeared across all datasets contributed to the five main themes reported in this paper, which can be identified using the acronym LEARN: **L**earning artefacts; **E**mbodied teaching and learning; **A**sking questions; **R**epetition; and **N**arrative. Each of these features of pedagogy was evident in the observational data and fostered children's engagement and participation. Finally, these five categories are not sequential, but instead are interdependent and incorporated throughout effective museum education programs, enabling children to LEARN.

Findings: LEARN elements

Learning artefacts

Museum education programs provide children with opportunities to interact with material, objects and spaces they would otherwise not encounter. Both excursions and outreach programs provide learning resources unique to museum exhibits, specifically in this study: shears, rocks, a taxidermy possum and possum skin pelt (Program A), and dinosaur bones and fossils (Program B). Teachers commented in the pre-visit questionnaire and the post-visit interview that the museum collections of artefacts is an important and engaging part of the learning experience, and one of the reasons they choose to participate in museum programs, providing children with "*an opportunity to explore objects they wouldn't normally get to*". Data in this project recorded children's fascination with a possum skin pelt (Program A), and the markings in fossils (Program B); this engagement was evident not only in the observational records (i.e. CLASS and the multiliteracy audit), but also observed by teachers in children's play *after* the museum visit. Importantly, museum presenters connected the novel artefacts in the

presentation to children's existing knowledge, for example explaining that "*dinosaur teeth are as big as a banana*", "*it's got a long neck like a giraffe*" or "*purple like a plum*".

The language used in the presentation is also a learning artefact, because museum programs introduce vocabulary the children may not otherwise encounter. For example, observation notes from Program B have recorded that:

> *"the museum presenter often uses advanced vocabulary, e.g. "Can you say brachiosaurus?"; "coprolite"; "shin"; "extinct". The museum presenter provides definitions for a variety of words, e.g. "a palaeontologist is a science detective looking for clues"; "those bones turn into a rock which we call a fossil"; "a Tsintaosaurus was a duck-billed dinosaur".*

Language use in the museum programs balanced vocabulary extension and descriptive processes (e.g. fossiliation) by using terms familiar to children. For example, museum presenters in Program B described the disintegration of flesh from the bones of dinosaurs as "*all the squishy bits have gone because of the wind and rain*". Children were able to feel and talk about the squishy bits of their own bodies, to reinforce the distinction between bone and skin, muscle and tissue. A strength of the two museum programs for these preschool children was the variety and novelty of artefacts to support learning. These artefacts included unfamiliar materials and objects and importantly, the children had the opportunity to interact with these items and use vocabulary that included novel words and concepts.

Embodied learning and teaching

Embodied learning – where children use their bodies and movement to make meaning – with the unique artefacts provided in the museum programs, was another notable finding in the project, as children were "a*ble to touch and feel the different objects*". Experiential learning has a long history in education with links to Dewey's (1934/2005, 2003) understanding of hands-on learning opportunities for children. In museums and galleries, this approach has been used as a "catalyst for inquiry" as children interact with each other, adults and objects through sensory experiences (Piscitelli & Penfold, 2015, p. 266). In Program A, most obviously children were able

to experience the museum space, see museum artefacts – and use a magnifying glass to inspect and manipulate feathers, rocks and beetles – but also experienced, as explained by one museum presenter, "*haptic learning through touching and feeling. How the different objects feel, soft, delicate, heavy, carved, stitched etcetera*". The sensory experience of touching the possum pelt (in Program A) was captivating for many of the children and was the object most frequently mentioned by them after the visit. The museum presenter in Program B invited children to lie down and measure themselves against the real-life size model of a Tsintaosaurus leg; mathematical concepts of measurement were explored kinaesthetically by the children. One Teacher commented that a highlight of Program B was, "*when they got to lie on the floor and measure themselves out with the bones*". In both datasets, there were frequent comments from teachers that the "hands-on" format was a key strength of both museum programs, and central to children's learning (see also Cekaite & Mondada, 2020; Dodek, 2012; Kern, 2021).

The multiliteracy audit of both programs recorded children's participation in the program through singing, clapping, stomping, touching, feeling the weight of objects, distinguishing muscle tissue and bone through touch, moving beetles on an artefact table, using their bodies to investigate relative measurement, and wrapping themselves in a possum skin pelt. Children's experience of the program involved all senses, for example, one child smelled the skull of a dinosaur and reported, "*it's not stinky*". Multimodal learning was evident not only in children's interactions with objects in both programs, but also notable in the presentation and the museum presenter's descriptions of artefacts. Museum presenters in both Programs used a range of modalities, pointing to objects and using gesture to explain action and concepts; for example, using a layering gesture with hands to illustrate the process of fossilisation. Research evidence tells us that opportunities for haptic learning supports children's engagement (Lee, 2020), and that gesture accompanying verbal explanations – e.g. demonstrating how to use a magnifying glass – enhances children's understanding of concepts (Novack & Goldin-Meadow, 2016). In Program A the museum presenters used the action of shearing sheep with the shears artefact, used their hands to symbolise walking, and modelled to the children how to pat the taxidermy possum gently, using one finger to stroke the fur. In Program B, the museum presenter and children walked around with one hand up above their heads pretending to be a

long-necked brachiosaurus dinosaur eating the leaves up high. The museum presenter in Program B uses a 'testing finger' to see if the teeth were sharp or flat, counting "*1, 2, 3*" before putting his finger in the model dinosaur's mouth and exclaiming "*Owwwwww*!", an effective use of tension appreciated by all groups evident in the children's laughter. The museum presenter in Program B asked the children to find their shin bone with their hands, used a gesture of spreading arms to indicate this size of whale skeletons housed at the museum, and moved fingers to demonstrate the "*creepy, crawly bugs and spiders*".

The teachers in this study emphasised the importance of visual cues to support young children's engagement ; photographs, drawings and images were used in both Programs, particularly to reinforce abstract concepts, such as time passing in the process of fossilisation. Teachers commented that visual prompts helped children anticipate the material objects or provide context for questions. Visual artefacts also make provision for children who have English as an additional language; as one teacher explained, "*we do that usually visually because of a lot of our families don't or can't read a lot of English, so we use a lot of visuals*". This responsiveness to the individual needs of children can be taken into account in education programs; for example, songs were used to great effect in young children's participation (Mullen, 2017), but a number of children were observed covering their ears during the singing in Program A. Due to considerable background noise, the museum presenters' microphone and the volume of other children clapping proved too great an auditory load for some children (see Eadie, Young, Suda & Church, in press, for further details about issues of access).

Asking questions

Having noted the prominence of novel artefacts and the opportunities in museum programs for children to engage with these resources in multiple modalities, it is important to emphasise that the materials in isolation do not *teach* concepts or vocabulary (see Jant et al., 2014; Whitin & Whitin, 2003, p.39). Although children do learn through embodied opportunities with material objects and place, it is the interaction with knowledgeable others – peers and adults – that creates connection between experience and concepts (Wellsby & Pexman, 2014; Vygotsky, 1962). We have seen in our data that artefacts and novel material objects are a key strength of

museum programs, but we are interested in how children and presenters interact with these objects. An important element of learning-in-interaction is the framing of questions posed by presenters (e.g. Dalgren, 2017). We know that the way in which presenters elicit responses from children shapes the trajectory of learning (Walsh, 2011), and ideally questions project a sequence of inquiry as participants engage in 'sustained shared thinking' (Siraj & Asani, 2015; Purdon, 2016). Importantly, the sustained here does not refer to temporal – i.e. asking a series of unrelated questions – but a sequence of attuned extensions of children's responses. Asking contingent questions creates collaborative exploration of concepts, and can be used to gauge children's understanding; engage children in content; scaffold ideas; and encourage group problem solving.

All five museum presenters asked questions to children throughout their presentations in both programs. The audio recording and observational data reveal that most questions in Program A were designed to invite participation from the children ("*has anyone seen a possum before*?") rather than pose problems to resolve. The CLASS observations noted that "*some children received targeted input, and questions or comments that supported their participation, but many did not*". Questions were also used to extend vocabulary (e.g. *coprolite*) and draw attention to specific features of each of the museum artefacts (e.g. "*where do feathers come from*?"). The observational data reveals that the museum presenters asked questions – with warmth and enthusiasm – to encourage children's participation, but that although "*the presenter asked questions, few required more than a one or two-word response*". In Program B, in contrast, questions were posed as part of the process of modelling scientific enquiry. As palaeontologists, the children were encouraged to 'look for clues', and this orientation to exploration is reinforced in the museum presenters' questions, e.g.,*"What do you see?", "What did you find in the fossils?", "What is that?" and acknowledging the child's response by affirming "that's a clue".* The observation notes also document that the museum presenter "*asked children to explain their thinking ('How do you know that? A dinosaur foot, how do you know? Oh you can see the toes. Bigger? Why do you say that?').* The data also show that in this program the museum presenter encourages reasoning with questions such as "*What do you think a big long neck could help this dinosaur do*?" and "*What would a spiky tail be good for*?".

The importance of asking questions is not limited to prompts posed by presenters, but also includes responding to spontaneous questions from children. To foster inquiry from the children, there needs to be sufficient time for children to raise questions in response to the museum presenters' explanations, and to ask impromptu questions. One of the children told the teacher after the excursion in Program A that "*I was putting my hand up, but no one asked me to speak u*p". The same teacher suggested that "*there should be a little bit more time if the child puts up their hand in between the conversation, maybe they can finish that sentence and then we'll say, 'Yes, what do you wanna ask*?'". Engaging and inviting children's questions was observed in Program B when the "*museum presenter provides information in response to children's comments or questions, for example about footprints ('It's from where they stepped in the mud') and how the museum gets fossils ('Some people find them at the beach and bring them to the museum')".* Research shows us that responding to children's questions, and extending these topics, can establish an unexpectedly rich site for exploration of concepts and abstract ideas (Church & Bateman, 2019; Clarkin-Phillips et al., 2018; Houen, Danby, Farrell & Thorpe, 2016).

Repetition

Repetition was a striking feature of the museum presenters' interactions with the children in both museum programs. The data documented all five museum presenters using repetition in one of two ways as a form of feedback for children. Firstly, repetition was used to give responsive, contingent feedback , e.g."*under the ground, that's right*", "*it's a herbivore, well done*" or, most frequently, repetition was observed when introducing new vocabulary. At the beginning of all presentations at the museum (Program A), "*the museum presenter used the word 'wominjeka', asks children to repeat the word*" and explained that this means welcome in the Woi-wurrung language of the Wurundjeri, First Nations peoples of the land where the museum is located in Melbourne, Australia. Importantly, repetition was evident not only in the content of the presentations, as museum presenters encouraged all the children to repeat the responses provided by one of their peers: "*The museum presenter asks children, 'Has anybody ever seen a living dinosaur?' Child suggests 'they are extinct' and the museum presenter asks*

children to repeat the word extinct. A child says 'triceratops' and the museum presenter asks children to repeat the word". This was not simply formulaic but provided opportunities for all children express the word.

When the museum presenter talked about dinosaur experts at the museum, he explained that "*we call these people palaeontologists*" and asked the children to repeat the word. *Palaeontologist* was then repeated by the museum presenter many times in the subsequent discussion, embedding the new vocabulary in the narrative and encouraging children to play the role of being a palaeontologist as they engaged in scientific thinking. The museum presenter used repetition when introducing all new lexicon, for example, explaining that the dinosaur liked to eat leaves, that it is a leaf eater, plant eater, or '*herbivore*' and asking children to repeat the word *herbivore*. The same request for repetition was made by the museum presenter with each of the dinosaur names. One of the museum presenters in Program B noted that timeliness, or the when-and-where of repetition of vocabulary, matters for retention: *"I referred back to the bag of dinosaurs too late in the session for the children to consolidate the names of the dinosaurs in their memories as they struggled to remember Brachiosaurus and Stegosaurus when questioned*".

Repetition is important in concept development (Bannard & Lieven, 2009; Horst, 2013), and both programs enabled children to return to or re-visit topics explored earlier in the presentation. For example, "*the museum presenter asks if the sharp teeth were for eating people and talks about dinosaurs and extinction again – that there were no people around when the dinosaurs were alive*." We should emphasise that each of these essential elements of pedagogy in museum programs (i.e. LEARN) can be concurrent. For example, when one museum presenter asked "*Who's never been to the museum, never*?", she used repetition, in a question format, with hand gesture to emphasise 'never'. Furthermore, the *context* in which this new vocabulary is introduced is central to tying the learning to meaningful experiences (Horst, 2013). This brings us to consider the role of narrative in creating effective education programs for young children.

Narratives

In telling stories, museum presenters were able to engage children's interest in new material objects and concepts enacted in a meaningful context. A story delivery mode was used in both Programs to introduce and explore the artefacts, to different effect. The beginning of Program A introduced the physical context or place with a story of two children going to visit their grandfather who lived on a river. Thereafter, artefacts were introduced to children, one by one, as being found in grandpa's shed. However, the story did not connect the objects; in effect there was no continuous narrative tying the artefacts together. This meant that each artefact stood on its own rather than connecting to a story whole. Program B, on the other hand, included a story about dinosaurs passing through time, the effect of flooding, and the process of fossilisation, providing a coherent arc for children to understand the contiguous processes of extinction and subsequent preservation of fossils. This story was shared through a sequence of pictures and animated delivery from the museum presenter. Not only did this allow for connectedness between artefacts, the sequence of the story supported the sequence of natural events in fossilisation and all parts of the program connected to the broader narrative. This finding is supported by commentary from several teachers – particularly with the Program B – that "*the story was the highlight*" and the fact that concepts (e.g. fossilisation) were embedded in a cohesive narrative, established contextual knowledge and meaning for the children.

Children's existing sense of narrative (Bruner, 2002) enables them to engage with a script, predicting an arc to the story, and having a sense of character for the protagonist artefacts. Narratives elicit problem solving and problem posing, and children are captivated by the unknown and peculiar parts of a story. In museums, learning through narrative inquiry engages children individually and as a collective (Carter, 2018); collaborative narrative learning opportunities are supported when adults encourage and elicit children's ideas into the narrative construction (Ødegaard & Pramling, 2013). In Program B, the narrative was supported by using pictures that describe or animate the process of fossilisation and asking children questions about the depictions they see in the book illustrations. This structure provided a robust framework for the narrative, which was effective in communicating the vast periods of

time as the condition for fossilisation. Repetition, as discussed above, was also a feature in both narratives, using a song with repeated chorus in Program A, and inviting children to join in the story in Program B with chants to cement concepts, e.g. the wind and the rain. "*The museum presenter used the words 'tick, tock, tick tock…' to represent the passing time – this was repeated throughout the story.*" Stories were also told with gesture to accompany the verbal narrative, either in miming action (e.g. driving the car to visit grandparents), or to emphasise words and events in the story (facilitating multimodal literacy learning). Children were invited to join in the story by clapping (Program A) or stomping (Program B). Research shows us that context is integral to learning (Ness, 2017), and the use of narrative provided a contextual frame of reference in both museum Programs, using stories to introduce artefacts and explain concepts.

Implications for the design and delivery of museum education programs

There are multiple elements of museum education programs that influence a positive experience for young children; the findings in this paper have focused on essential elements in the enactment of programs for preschool-aged children. Systematic observations (using CLASS and a multiliteracy audit) and reflections from early childhood teachers and museum presenters have revealed that learning resources, embodied learning and teaching, asking questions, repetition and narrative (i.e. LEARN, see Figure 2) are pervasive features of programs that engage children's interests, introduce new concepts, and encourage scientific thinking. We are not making claims that these categories are exhaustive, but rather that they were prominent in our data and are foundational to the effectiveness of museum programs for young children's learning. These five requisite conditions for learning observed during the museum visits are substantiated by research evidence in early childhood education, as indicated throughout this paper. Furthermore, we should note that a discrete education program is only one part of the learning experience offered by museums, as the site itself, the opportunity to move through large-scale exhibits and encounter novel spaces and objects – and interact with these objects – extends opportunities for learning beyond the formal ''program' delivery (see Hooper-Greenhill & Moussouri, 2006)

[insert Figure 2 here]

Figure 2: LEARN: Essential elements of museum programs for young children.

The implications for designing programs at museums to engage young children include structural and interactional elements. Structural elements include embedding a core narrative around the concept/s to focus the visit as well as giving time and space for children's individual narratives to build shared learning (Carter, 2018; Lee, 2020). Hands-on explorations with museum artefacts that are novel and unique have the potential to engage children's curiosity in the learning focus (as documented elsewhere, e.g. Jant, Haden, Uttal, & Babcock, 2014; Wolf & Wood, 2015). We should note that our study of pedagogy took place across two distinct types of museum programs which have different aims and capacities: outreach programs can focus on pedagogy within the discrete program – with fewer distractions as children are in the familiar environment of their preschool – but visits to the museum offer broader learning opportunities as children move through the museum exhibits and space.

The findings in this study, however, have highlighted that it is the child-adult interactions within and with these structural elements of museum programs that are crucial to children's learning. For example, museum presenters who ask questions encourage children to share their thinking and build on conceptual knowledge explored in the museum program. Repeating new concepts and – perhaps even more importantly – allowing children to ask questions during their visit sustains inquiry-based learning. Others have noted that, what children gain from museum experiences is "determined by a combination of what they do and what they talk about" (Jant, et al., 2014, p. 2039), but we would add that *how* they talk about the exhibit is integral to creating substantive learning experiences.

The findings in this project have illustrated that where museum programs encourage exploration or extension of children's own experiences, they create sustained opportunities for engaged learning. Connections to children's existing world knowledge were made explicit by experienced museum presenters in this study, emphasising the importance of contiguity of children's interaction with the content and concepts of museum programs. Future research

should aim to learn more about what early childhood teachers can do pre-and-post museum to extend learning opportunities for children, by familiarisation before the visit, and re-visiting concepts after the visit to embed and extend children's understanding of the unique content of the museum program. Museum staff can build on their content expertise by focusing on mechanisms of teaching and learning, enabling productive questions and opportunities for children's exploration of concepts. As museums offer a world of novel resources to children and their families, a focus on LEARNing can support children's engagement and experience at the museum.

References

Andre, L., Durksen, T., & Volman, M. L. (2017). Museums as avenues of learning for children: a decade of research. *Learning environments research*, 20(1), 47–76. https://doi.org/10.1007/s10984-016-9222-9

Atkinson, S. (2017). *Possum skin pedagogy: A guide for early childhood practitioners.* Warrawong Foundation.

Black, G. (2012). *The engaging museum: Developing museums for visitor involvement*. London: Routledge. https://doi.org/10.4324/9780203559277

Brown, R., Jeanneret, N., & Andersen, J. (2019). Are we on the same page? Family and museum staff perceptions of engagement and learning. *Visitor Studies, 22*(2), 213-232. doi:10.1080/10645578.2019.1668235

Bruner, J. (2002). *Making stories: Law, literature, life*. Cambridge, MA: Harvard University Press.

Callanan, M. A., Castañeda, C. L., Luce, M. R., & Martin, J. L. (2017). Family science talk in museums: Predicting children's engagement from variations in talk and activity. *Child Development*, 88(5), 1492–1504. https://doi.org/10.1111/cdev.12886

Carter, D. (2018). Narrative learning as theory and method in arts and museum education. *Studies in Art Education*, 59(2), 126–144. https://doi.org/10.1080/00393541.2018.1442548

Cekaite, A. & Mondada, L. (2020). *Touch in social control: Touch, language and body.* London: Routledge.

Church, A. & Bateman, A. (2022) T*alking with children: A handbook on interaction in early childhood education.* Cambridge: Cambridge University Press.

Church, A. & Bateman, A. (2019). Children's right to participate: How can teachers extend child-initiated learning sequences? *International Journal of Early Childhood*, 51(3), 265. doi: 10.1007/s13158-019-00250-7

Clarkin–Phillips, J., Carr, M., Thomas, R., Tinning, A., & Waitai, M. (2018). Fostering the artistic and imaginative capacities of young children: Case study report from a visit to a museum. *International Journal of Early Childhood*, 50(1), 33–46. https://doi.org/10.1007/s13158-018-0211-2

Cope, B. & and Kalantzis, M. (Eds) (2000). *Multiliteracies: Literacy learning and the design of social futures*. London: Routledge.

Dalgren, S. (2017) Questions and answers, a seesaw and embodied action: How a preschool teacher and children accomplish educational practice. In Bateman, A. & Church, A. (Eds.) *Children's knowledge-in-interaction: Studies in conversation analysis* (pp. 37-56). Singapore: Springer.

Dewey, J. (1934/2005). *Art as experience*. New York: Capricorn Books.

Dodek, W. L. (2012). Bringing art to life through multi-sensory tours. *Journal of Museum Education*, 37(1), 115–124. https://doi.org/10.1080/10598650.2012.11510723

Eadie, P., Young, S., Suda, L. & Church (in press) Facilitator and teacher perspectives on

museum programs for young children. *Journal of Museum Education.*

Falk, J. H., & Dierking, L. D. (2016). *The museum experience revisited*. Walnut Creek: Routledge.

Foreman-Peck, L., & Travers, K. (2013). What is distinctive about museum pedagogy and how can museums best support learning in schools? An action research inquiry into the practice of three regional museums. *Educational Action Research*, 21(1), 28–41.

Haden, C. A. (2010). Talking about science in museums. *Child Development Perspectives*, 4(1), 62–67. https://doi.org/10.1111/j.1750-8606.2009.00119.x

Hamre, B. K., Downer, J. T., Jamil, F. M., & Pianta, R. C. (2012). Enhancing teacher's intentional use of effective interactions with children: Designing and testing professional interactions with children. In R. C. Pianta, S. W. Barnett, L. M. Justice, & S. M. Sheridan (Eds.), *Handbook of early childhood* (pp. 507-532). Guilford Press: New York.

Hindley, A. F., & Olsen Edwards, J. (2017). Early childhood racial identity –The potential powerful role for museum programing. *Journal of Museum Education*, 42(1), 13–21. https://doi.org/10.1080/10598650.2016.1265851

Hooper-Greenhill, E., & Moussouri, T. (2006). Researching learning in museums and galleries 1990-1999: a bibliographic review. *University of Leicester - Museum Studies*, 47. Retrieved from http://hdl.handle.net/2381/19

Horst, J.S. (2013). Context and repetition in word learning. *Frontiers in Psychology*, 4, 149. doi: 10.3389/fpsyg.2013.00149

Houen, S., Danby, S., Farrell, A. & Thorpe, K. (2016) "I wonder..." formulations in teacher-child interactions. *Journal of Early Childhood*, 48(3), 259-276.

Jant, E. A., Haden, C. A., Uttal, D. H., & Babcock, E. (2014). Conversation and object manipulation influence children's learning in a museum. *Child Develop*ment, 85(5), 2029–2045. https://doi.org/10.1111/cdev.12252

Kern, F. (2021) Embodiment. In A.Church & A. Bateman (Eds.) *Talking with children: A handbook on interaction in early childhood education*. Cambridge: Cambridge University Press.

Lee, T. S. C. (2020). Curriculum based interactive exhibition design and family's learning experiences: A case study of the Children's Art Museum in Taipei. *Curator: The Museum Journal*, 63(1), 83-98.

Leftwich, M., & Haywood, C. (2016). The Littlest Historians: Early Years Programming in History Museums. *Journal of Museum Education*, 41(3), 152–164. https://doi.org/10.1080/10598650.2016.1198132

Lifschitz-Grant, N. (2018). Mornings at the museums: A family friendly early childhood program. *Journal of Museum Education*, 43(3), 260–273. https://doi.org/10.1080/10598650.2018.1483159

Lemon, N., & Garvis, S. (2014). Perceptions of pre-service teachers value of art museums and galleries. *Journal of Museum Education*, *39*(1), 28–41. https://doi.org/10.1080/10598650.2014.11510793

Mallos, M. (2012). Collaboration is the Key: Artists, Museums, and Children. *Journal of Museum Educatio*n, 37(1), 69–80. https://doi.org/10.1080/10598650.2012.11510719

Munley, M.E. (2012). *Early learning in museums: A review of the literature. Report for Smithsonian Institution's Early Learning Collaborative Network*. Retrieved from http://www.si.edu/Content/SEEC/docs/mem%20literature%20review%20early%20learning%20in%20museums%20final%204%2012%202012.pdf

Mullen, G. (2017). More than words: Using nursery rhymes and songs to support domains of child development. *Journal of Childhood Studies, 42*(2), 42. doi:10.18357/jcs.v42i2.17841

Ness, M. (2017). Using informational and narrative picture walks to promote student-generated questions. *Early Childhood Education Journal*, 45(5), 575-581.

Novack, M., & Goldin-Meadow, S. (2015). Learning from gesture: How our hands change our minds. *Educational Psychology Review*, 27(3), 405-412. doi:10.1007/s10648-015-9325-3

Ødegaard, E. E., & Pramling, N. (2013). Collaborative narrative as linguistic artifact and cultural tool for meaning making and learning. *Cultural-Historical Psychology, 2*(3), 38–44.

Pianta, R. C., La Paro, K. M., & Hamre, B. K. (2008). Classroom Assessment Scoring System™: Manual K-3. Baltimore: Paul H Brookes.

Piscitelli, B., & Anderson, D. (2007). Young children's perspectives of museum settings and experiences. *Museum Management and Curatorship, 19*(3), 269-282. doi:10.1080/09647770100401903

Piscitelli, B., & Penfold, L. (2015). Child-centered practice in museums: Experiential learning through creative play at the Ipswich Art Gallery. *The Museum Journal*, 58, 263-280.

Piscitelli, B., & Weier, K. (2002). Learning with, through, and about art: The role of social interactions. In S. Paris, G. (Ed.), *Perspectives on object-centered learning in museums* (pp. 121–151). Mahwah, N.J.: Lawrence Erlbaum Associates.

Purdon, A. (2016) Sustained shared thinking in an early childhood setting: an exploration of practitioners' perspectives, *Education 3-13*, 44:3, 269-282, DOI: 10.1080/03004279.2014.907819

Siraj, I. & Asani, R. (2015). The role of sustained shared thinking, play and metacognition in young children's learning. In S. Robson & S. Flannery. Quinn (Eds.), *Routledge International Handbook of Young Children's Thinking and Understanding* (pp. 403-415). London: Routledge.

Sirinides, P., Fink, R., & DuBois, T. (2017). A study of early learning services in museums and libraries. *Early Childhood Education Journal*, 45(4), 563–573. https://doi.org/10.1007/s10643-016-0820-z

Tayler, C., Ishimine, K., Cloney, D., Cleveland, G., &Thorpe, K. (2013).The quality of early childhood education and care services in Australia. *Australasian Journal of Early Childhood*, 38 (2), 13-21.

Vygotsky, L. (1962). *Thinking and speech*. Cambridge, MA: The M.I.T. Press.

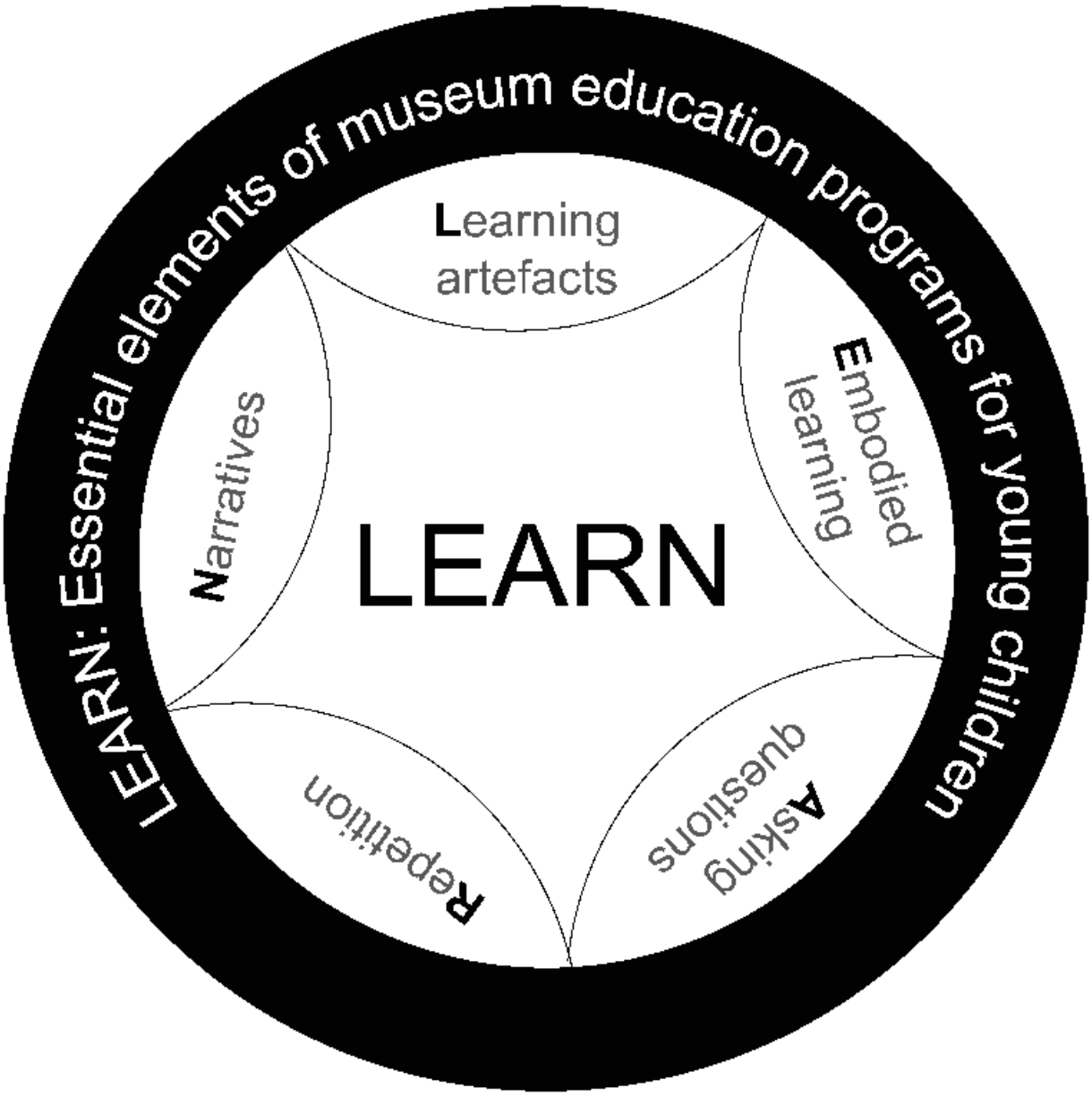
Walsh, S. (2011) *Exploring Classroom Discourse: Language in Action*. London: Routledge.

Wellsby, M., & Pexman, P. M. (2014). Developing embodied cognition: insights from children's concepts and language processing. *Frontiers in psychology*, 5, 506. https://doi.org/10.3389/fpsyg.2014.00506

Whitln, P., & Whitin, D. J. (2003). Developing mathematical understanding along the yellow brick road. *Young Children*, 58(1), 36-40.

Wolf, B., & Wood, E. (2015). Integrating scaffolding experiences for the youngest visitors in museums. *Journal of Museum Education*, 37(1), 29-37. doi:10.1080/10598650.2012.11510715

cura_12456_f1.jpg



cura_12456_f2.png