ABSTRACT
Museums offer children unique opportunities for meaningful learning, and over time, have evolved from being adult oriented to child-friendly places. Today, museum vision statements often include a commitment to lifelong learning and young visitors are viewed as an important museum-going audience. Consequently, museums are looking for ways to design exhibitions and programs that accommodate children’s learning needs. In this context, the Queensland Museum developed a set of resource trolleys to introduce young visitors to museums and their collections. This paper reports findings from a study that evaluated the impact child-centered discovery trolleys have on 4-8 year old children’s museum experiences. Findings from this study add to the body of knowledge on this topic and may have important implications for designing museum experiences that stimulate children’s interest in museums and increase learning outcomes.

INTRODUCTION
The Queensland Museum (QM), with funding from the Australia Council for the Arts, developed a set of mobile resource units or “trolleys” to introduce young visitors to museums and their collections. The What’s Inside? (WI) project was designed to encourage child-centered practices within the museum and engage children in hands-on learning. Current understandings about cognitive development and early childhood education were incorporated into the design of the trolleys, providing children with opportunities for choice, play, and social interaction.

Current learning theories support the view that every child is a unique individual with personal interests and learning preferences. Howard Gardner’s “multiple intelligences” theory claims that individuals possess different kinds of intelligences including: linguistic, spatial, logical-mathematical, musical, bodily-kinesthetic, naturalistic, interpersonal, and intrapersonal (Gardner, 2000). One implication of this theory is that learning experiences should be designed to encourage development of all intelligences. In the museum setting this means creating an environment where children can choose to explore topics in a variety of ways.

In addition to multiple intelligences, children also have individual learning styles—strengths and differences in the ways each child prefers to process new information (Dunn, Dunn & Perrin, 1994). Included in children’s individual learning styles are perception preferences. For example, some children may prefer to learn by looking, others may prefer to learn by listening, others by touching, and some may prefer to learn by doing. In order to maximize opportunities for learning, museum experiences should be designed to provide a variety of modes of learning such as visual, auditory, tactile, and kinesthetic. Providing children with opportunities for choice and control have been shown to stimulate children’s learning during museum visits (Csikszentmihalyi & Hermanson, 1995; Falk & Dierking, 2000; Paris, 1997; Perry, 1994; Piscitelli, Weier & Everett, 2003). When children decide what they want to do and how long they want to do it, they gain a sense of empowerment and ownership of the learning process (Falk & Dierking, 2000).

Play is widely accepted as a precursor of formal learning. Both Piaget (1951) and Vygotsky (1978) incorporated theories of play into their broader theories of cognitive development. In recent years there has been increased research in the area of children’s play and its influence on learning. Engaging in play helps children to:

• understand their own capabilities and identity, the physical world around them, and social relationships and social settings (Nicolopoulou, 1993);
• gain a sense of power and control that comes from mastering new experiences, ideas, and concerns;
• learn new concepts, explore new attitudes, and develop new skills;
• transform their experiences into creations that are uniquely their own; and
• build meaningful connections between their experiences at home, at school, and in the community (Levin, 2000).

An important factor contributing to learning outcomes that result from play experiences is the nature of adult/child interactions that take place during play. Levin (2000) states that “supported by adults, play can provide an effective vehicle for working on a variety of concepts and skills that are important for young children to learn” (p. 56).

The value of play experiences is supported in the museum literature. The play-based approach to learning adopted by many children’s museums has been found to enhance learning by providing children with hands-on, interactive environments that stimulate their motivation and interest (Speaker, 2001). Play experiences in museum settings have also been found to be a platform for memorable learning for young children (Anderson, Piscitelli, Weier, Everett & Tayler, 2002).

The role social interactions play in influencing children’s learning is not to be underestimated. Social constructivists such as Vygotsky focus on the social influences on learning. Vygotsky’s “social development theory” is based on the view that learning does not take place apart from the social world. Vygotsky (1978) argued that cognition develops through interaction with others; the learner socially constructs meaning.

Research in the area of learning in museums supports the view that social interactions play an important role in learning outcomes (Borun, Chambers, & Cleghorn, 1996; Crowley & Callanan, 1998; Falk & Dierking, 2000, Hein, 1998; Piscitelli & Weier, 2002; Wolins, Jensen, & Ulzheimer, 1992). Falk and Dierking (2000) argue that meaningful learning experiences in museum settings are derived from shared experiences—conversation with and observation of others. They suggest that although learning is both an individual and group process, “learning, particularly in museums, is a fundamentally social experience” (p. 38). Because children visit museums in social groups, social interactions that occur during the visit play an integral part in the learning process.

Based on our understandings of play, choice, and social cognition, the purpose of the What’s Inside? study was to investigate the impact child-centered discovery trolleys have on young children’s museum experiences, and in particular on their perceptions of museums, enjoyment, and learning. Such information may have important implications for designing museum experiences that stimulate children’s interest in museums and increase learning outcomes.

METHODS

Eight WI trolleys were constructed for the project—four “self-guided” units (Life in the Outback, Marine Reptiles, Dinosaurs, and Discover Queensland) and four “guided” units (Taxonomy, Material Culture, Mammals, and Welcome & Orientation). “Self-guided” trolleys were designed to be used as unstructured, free-choice experiences facilitated by QM volunteers. “Guided” trolley experiences included a 15 minute introduction provided by a member of the education staff, followed by 15 minutes of free-exploration. Themes for the trolleys were selected to complement the permanent exhibitions.

The trolleys were designed to be mobile so that they could be wheeled on and off the floor and moved to a variety of locations. All trolleys contain a variety of hands-on resources including artifacts and specimens (originals and replicas), dress-ups, puppets, puzzles, books, and materials for drawing (see Figure 1).

Participants

Four classes from two schools were invited to participate in the study. Although ninety children participated in the museum visit program, due to child absences and a low return rate of consent forms by parents from one class, 66 children (ages 4 – 8) took part in the research (see Tables 1 and 2 below for children’s grade level and gender). Four teachers also participated in the study.

Figure 1. What’s Inside? Mammals trolley

Photo by David Fittell
Table 1. Grade levels

<table>
<thead>
<tr>
<th>Grade</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-school</td>
<td>18</td>
<td>27.3</td>
</tr>
<tr>
<td>1st</td>
<td>41</td>
<td>62.1</td>
</tr>
<tr>
<td>1st &amp; 2nd</td>
<td>7</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>66</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Table 2. Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girl</td>
<td>34</td>
<td>51.5</td>
</tr>
<tr>
<td>Boy</td>
<td>32</td>
<td>48.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>66</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Procedure

Pre- and post-visit questionnaires, observations, and photographs were the primary data generation methods used to evaluate the impact the hands-on trolleys had on young children’s museum experiences (see Table 3 for data collection strategies used). Questionnaires were developed by the museum researcher in consultation with QM staff and participating teachers (see Appendix for a sample of questions from pre- and post-visit child questionnaires). Data were collected by the QM researcher, QM education staff, and museum volunteers.

Approximately two weeks before the visit, the researcher and a member of the museum education staff visited the four classrooms to administer the pre-visit questionnaire. Child questionnaires were orally administered on an individual basis. Pre-visit questionnaires probed children’s past visiting history and perceptions of museums. Questionnaires consisted of both closed response and open-ended questions. One week prior to the museum visit, the researcher made a second visit to each of the four classes and provided the children with a 30 minute overview of the museum visit. During the classroom session children were shown pictures of the trolleys they would be using during the visit.

Informal meetings were held with teachers to discuss the content and structure of the museum visit. The selection of WI trolleys used during the visit was influenced by the school curriculum. For example, students from School 1 used the Dinosaurs trolley during their museum visit because they were learning about dinosaurs at school. Each class used three different trolleys during their visit—one “guided” and two “self-guided” experiences (see Table 4 for trolleys used).

The two participating schools visited the museum on separate days. During the on-site visit children toured the museum in groups that consisted of 9–13 students, 1–2 adult chaperones (teacher and/or parents), a museum volunteer guide, and a researcher (to record observations). While at the “self-guided” trolleys, children were free to engage in activities of their choosing. Facilitators (museum volunteers) offered assistance and interpretation. The “guided” trolley experiences consisted of a 15 minute introduction provided by a member of the education staff, followed by 15 minutes of

Table 3. Data collection strategies

<table>
<thead>
<tr>
<th>Data Collection Period</th>
<th>Methods</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-visit</td>
<td>Child orally administered questionnaire</td>
<td>66 Children</td>
</tr>
<tr>
<td>Visit</td>
<td>Observations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Photographs</td>
<td></td>
</tr>
<tr>
<td>Post-visit</td>
<td>Child orally administered questionnaire</td>
<td>55 Children</td>
</tr>
<tr>
<td></td>
<td>Teacher questionnaire</td>
<td>4 Teachers</td>
</tr>
</tbody>
</table>

Table 4. Trolleys used during museum visit

<table>
<thead>
<tr>
<th>School</th>
<th>Grade level</th>
<th>Trolleys</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>1st</td>
<td>Welcome &amp; Orientation – guided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dinosaurs – self-guided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marine Reptiles – self-guided</td>
</tr>
<tr>
<td>School 2</td>
<td>Pre-school</td>
<td>Mammals – guided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Life in the Outback – self-guided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marine Reptiles – self-guided</td>
</tr>
<tr>
<td></td>
<td>1st &amp; 2nd</td>
<td>Taxonomy – guided</td>
</tr>
<tr>
<td></td>
<td>(combined)</td>
<td>Life in the Outback – self-guided</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marine Reptiles – self-guided</td>
</tr>
</tbody>
</table>
free-exploration. Observations and photographs were used to record children’s interactions with the trolleys. Observations focused on describing children’s physical, cognitive, emotional, and social engagement.

A week after the museum visit, the researcher and museum education staff member re-visited the four classrooms to administer the post-visit questionnaire. Questionnaires were orally administered on an individual basis. During this session, children were asked the same questions concerning their perceptions of museums and additional questions pertaining to the impact of the trolleys, specifically in regards to enjoyment and learning.

In addition to the child questionnaires, teachers were asked to complete a post-visit questionnaire to gain their perspective on the impact the trolleys had on students’ enjoyment and learning.

RESULTS

Responses to open-ended questionnaire questions and observational data were coded, and statistics were generated from closed response questions. Results will be discussed in the following areas: perceptions of museums, enjoyment, and learning.

Perceptions of museums

Overall, children in this study held positive perceptions of museums. The data suggest that participants’ perceptions of museums changed as a result of the WI interactive experience. Before the visit, children’s perceptions of museums focused on dinosaurs and dinosaur-related items such as bones and skeletons. After the visit, although children’s perceptions continued to be dinosaur-focused, they perceived the museum to be a place where you see animals, olden day objects, and items for children such as toys, dress-ups, and puppets—all features of the WI trolleys.

Children viewed museums as “fun” places with “lots” of things for kids to do before and after the WI visit. Children’s perceptions of how much they would “talk with friends”, “play”, “touch things” and “look at things” increased considerably after the visit.

Table 5. How often do / would you do the following things during a visit to a museum?

<table>
<thead>
<tr>
<th></th>
<th>Pre-visit</th>
<th></th>
<th></th>
<th>Post-visit</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>A little</td>
<td>A lot</td>
<td>Never</td>
<td>A little</td>
<td>A lot</td>
</tr>
<tr>
<td>Touch things</td>
<td>34%</td>
<td>40%</td>
<td>22%</td>
<td>7%</td>
<td>55%</td>
<td>35%</td>
</tr>
<tr>
<td>Play</td>
<td>35%</td>
<td>31%</td>
<td>31%</td>
<td>5%</td>
<td>44%</td>
<td>51%</td>
</tr>
<tr>
<td>Look at things</td>
<td>0%</td>
<td>18%</td>
<td>79%</td>
<td>0%</td>
<td>9%</td>
<td>91%</td>
</tr>
<tr>
<td>Learn</td>
<td>4%</td>
<td>20%</td>
<td>73%</td>
<td>2%</td>
<td>22%</td>
<td>76%</td>
</tr>
<tr>
<td>Talk with friends</td>
<td>20%</td>
<td>36%</td>
<td>40%</td>
<td>4%</td>
<td>31%</td>
<td>65%</td>
</tr>
</tbody>
</table>

Table 6. A sample of responses to the question “Why do you think we have museums?”

<table>
<thead>
<tr>
<th>Pre-visit</th>
<th>Post-visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>No response.</td>
<td>‘Cause people like museums. It’s fun.</td>
</tr>
<tr>
<td>To show dinosaur bones.</td>
<td>To collect things and display them.</td>
</tr>
<tr>
<td>They tell you all about dinosaurs.</td>
<td>To show you all about the dinosaurs and things about a long time ago.</td>
</tr>
<tr>
<td>Study about dinosaur bones.</td>
<td>For people to learn about the olden days and dinosaurs.</td>
</tr>
<tr>
<td>No response.</td>
<td>So people can look. So people can play sometimes.</td>
</tr>
<tr>
<td>To see things.</td>
<td>We look for things. They have dress-ups and bats and possums.</td>
</tr>
<tr>
<td>No response.</td>
<td>Because you can look at things, touch things, and see things.</td>
</tr>
</tbody>
</table>
Hands-on Trolleys: Facilitating Learning Through Play

Children’s perceptions about what they would learn about in museums changed over the duration of the project. After the WI museum visit, a higher percentage of children indicated that they would learn about animals, olden day things, rocks/fossils, dinosaurs, and oceans—all topics featured in the WI Trolleys.

Data from child questionnaires indicate that child-centered resources and trolley activities facilitate children’s understanding of museums, their collections, and exhibitions. Table 6 reports a sample of children’s pre- and post-visit responses to the question “Why do you think we have museums?”. These suggest that the children gained a greater understanding about the museum and were more likely to view museums as child-friendly places as a result of their interactions with the WI trolleys.

Enjoyment

Children provided overwhelmingly positive comments about their experiences with the WI trolleys. The majority of children stated that they liked using the trolleys “a lot.” Few children provided responses to the question asking them if there was anything about the trolleys that they did not like. Features of the trolleys children liked best included: dress-ups, puppets, toy/games, and touching the specimens and artifacts.

Overall, observational data shows children demonstrated high levels of interest and involvement at each of the WI trolleys. High levels of engagement and enjoyment were observed during both “guided” and “self-guided” trolley experiences. Laughter, excitement, and amazement were emotions commonly expressed by children. Children actively participated in “play” activity—using puppets, dress-ups, making puzzles, and playing with “olden day” toys.

Learning

In response to the question asking them about their learning, the majority of children stated that they thought they had learned something new while using the trolleys. Children indicated that they learned in many different ways—by looking, touching, doing, and listening. Specific WI resources such as puppets, models, dinosaur footprint mats, fossils, and artifacts/specimens were referred to in children’s learning statements, for example:

Figure 2. Children engage in a range of activities – playing with puppets, dress-ups, and touching specimens

Photos by David Fittell
The trolleys’ resources and activities encouraged children to engage in many forms of social interaction—peer to peer, adult to child, and child to adult. Children reported learning from both adult interpretation and through self-discovery. Children’s learning statements suggest that learning resulted from both guided and self-guided experiences. The interpretation provided by facilitators was identified as playing a significant role in guiding children’s learning and shaping learning outcomes. Training sessions for facilitators focusing on techniques for interacting with young children were built into the design of the project.

Facilitators guided children’s learning by explaining, asking questions, and providing links between the resources and the exhibition (see Figure 3). Although children gravitated to the puppets and dress-ups, they demonstrated high levels of interest in learning about specimens and artifacts when facilitators used strategies such as story telling and guessing games.

Teachers viewed students’ interactions with the WI trolley as a valuable learning experience. Features of the trolleys identified as impacting learning outcomes included: “hands-on,” “active” learning, and facilitators providing “a nurturing environment for learning.”

The location and physical space devoted to the trolleys were two additional features of the trolleys that may have increased opportunities for learning. Locating the trolleys in close proximity to the exhibition served to both introduce the topic and reinforce learning. For example, after a child finished making a sea snake puzzle at the Marine Reptiles WI trolley, a facilitator led the child to the Marine Reptiles exhibition to watch the video of a sea snake swimming in the ocean. Having adequate space for both quiet activities such as reading and drawing, as well as large open spaces for active play (such as dress-up) was another feature of the trolleys’ design that assisted in accommodating children’s individual learning preferences.

CONCLUSION

The results of this study suggest that child-centered resources make a positive impact on children’s museum experiences. The child-centered features incorporated into the design of the trolleys—providing children with opportunities for choice, play, and social interaction - played an instrumental role in creating a successful learning environment for young children. The content of the trolleys, having a range of hands-on resources and activities, provided children with an opportunity to engage in activities of their choosing. They could follow their own interests and participate in activities that matched their individual learning styles. The play-based design of the trolleys facilitated active learning and heightened children’s enthusiasm and creativity. The activities and resources also encouraged children to interact socially with their classmates and adults. Interpretation provided by museum facilitators played an important role in guiding children’s learning.

Findings from this study also suggest that children’s perceptions of museums changed as a result of the WI museum experience. Children’s perceptions moved from a narrow “dinosaurs” focus to an expanded view about what could be seen and done in museums. After the visit, children’s descriptions of museums included child-friendly terms such as “play,” “touch,” and “fun.” Innovations such as hands-on trolleys provide children with opportunities for a highly enjoyable learning experience and provide museums with opportunities to stimulate children’s interest in museums and better serve the learning needs of young visitors.

REFERENCES


Borun, M., Chambers, C., & Cleghorn, A. (1996). Families are Learning in
Hands-on Trolleys: Facilitating Learning Through Play


**NOTE**

1. The Queensland Museum is a social and natural history museum located in Brisbane, Australia.

**ABOUT THE AUTHORS**

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Photos by David Fittell
[Pre-Visit Questionnaire]
Have you ever visited the Queensland Museum? (How many times? With whom?)

[Pre- & Post-Visit Questionnaires]
Perceptions of museums
1) Tell me what you think a museum is.
2) Why do you think we have museums?
3) Who do you think visits museums? [✓ Tick all that apply]
   □ Kids  □ Adults  □ Families  □ Teachers
4) What sorts of things do/would you see at museums?
5) What sorts of things do/would you do at museums?
6) What sorts of things do/would you learn about at museums? [✓ Tick all that apply]
   □ Animals  □ Computers  □ Plants
   □ Art  □ Olden day things  □ Rocks / Fossils
   □ Dinosaurs  □ Trains  □ Oceans
   □ Other _________________________________________
7) What sorts of things do you think people who work in museums do?
8) Do you think visiting a museum would be/is…
   □ fun  □ just ok  □ boring
9) How much stuff do you think there is for kids to do at museums?
   □ nothing  □ a little  □ a lot
10) How often do/would you do these things during a visit to a museum?
   Touch things  □ never  □ a little  □ a lot
   Play  □ never  □ a little  □ a lot
   Look at things  □ never  □ a little  □ a lot
   Learn  □ never  □ a little  □ a lot
   Talk with friends  □ never  □ a little  □ a lot

[Post-Visit Questionnaire]
Impact of the What’s Inside? trolleys
11) What did you like best about your museum visit?
12) Was there anything that you didn’t like about your museum visit?
13) Which trolley did you like the best? [Rank order 1st, 2nd, 3rd]
   Orientation ____ Mammals ____ Taxonomy ____
   Marine Reptiles ____ Dinosaurs ____ Life in the Outback ____
   [Go through each trolley used, one at a time (in order of preference), asking children the same series of questions] [Circle Unit]
   Orientation  Mammals  Taxonomy  Marine Reptiles  Dinosaurs  Outback
14) How much did you like using this What’s Inside unit?
   □ not at all  □ a little bit  □ a lot
15) What did you like best about it?
16) Was there anything that you didn’t like about it?
17) Did you learn (find out) anything new (get any new ideas) about… [museums, animals, marine reptiles, life in the olden days, etc.] while you were using it?
   □ Yes (If yes, what? How?)  □ No  □ Not sure