| P-ISSN: 2709-6254 | Journal of Development and Social Sciences | October-Dec 2024, Vol. 5, No. 4 |
|---|---|---|
| O-ISSN:2709-6262 | https://doi.org/10.47205/jdss.2024(5-IV)06 | [58-66] |

JDSS Journal of Development and Social Sciences
www.jdss.org.pk

RESEARCH PAPER

# Children's Interactive Experiences and Meaning Making of Scientific Exhibits at Community Museum

**[1]Azhar Majeed Qureshi* [2] Syed Nasir Hussain and [3] Salman Khalil**

1. Assistant Professor, Department of Science Education, Allama Iqbal Open University, Islamabad, Pakistan
2. Assistant Professor, Department of ECE & Elementary Teacher Education, Allama Iqbal Open University, Islamabad, Pakistan
3. Lecturer, Department of ECE & Elementary Teacher Education, Allama Iqbal Open University, Islamabad, Pakistan

***Corresponding Author:** azhar.majeed@aiou.edu.pk

**ABSTRACT**

The purpose of this study was to explore the interactive experiences and meaning-making strategies of science learning among children. By observing their informal science learning activities in a community natural history and science museum of Atlanta (USA), this research tries to understand children's quest for science knowledge and possible evidence for science meaning-making. The nature of the study was qualitative, and ethnography was used as the methodology. Two primary sources of evidence for science learning were included: dialogic conversations between children and their parents and children's behaviors as they interacted with certain exhibits within the Nature Quest area of the community museum. Only observations and field notes were used for data collection. Only children's interactive exhibit experiences were selected for the study analysis. Three themes of personification, essence, and functional reasoning based on Ash (2003) framework were used to explore the children's biological understandings of exhibits. An additional theme of problem-solving and collaborative skills emerged due to the specific nature of a few exhibits. Through these thematic analyses, children's meaning-making in the type of interactions was explored. The findings of the study indicate that most of their interactive experiences were brief and did not involve an in-depth scientific meaning-making process. However, it was evident that children had fun and remained engaged consistently with these exhibits, and their meaning-making of scientific phenomena was stress-free. Problem-solving was most apparent as a strategy in their search for scientific knowledge. So, vibrant learning environments must be created in such places to inspire curiosity and foster a deeper appreciation for science learning among children.

**KEYWORDS** Community Museum, Informal Science Learning, Interactive Experiences, Meaning Making

## Introduction

Science learning is a lifelong process. It can take place both in and out of school. The out-of-school activities can be distinguished as informal and non-formal science learning. What types of learning usually involve self-motivation, based on needs and interests, and can be sustainable (Dierking et al, 2003). Formal scientific education is typically characterized as learning about science provided in a classroom. Whereas informal science learning involves the study of science by students in non-school settings, including science camps, museums, after-school or extracurricular organizations, and media (Hofstein & Rosenfeld, 1996). Although traditional classroom environments are important for the transfer of scientific knowledge, these informal settings provide interactive displays, practical experiences, and real-world applications that can improve academic science learning. Archer et al (2020) analyzed the STEM outcomes as support of informal learning activities and found a strong connection between them.

Informal science learning refers to free choices in acquiring scientific knowledge and abilities outside of traditional educational settings. This includes learning opportunities in museums, nature centres, science clubs, and other non-classroom settings (Falk & Dierking, 2016). Its life long, out-of-school experiences to learn science. Such learning outside the formal education system may spread most of our lives. There are a lot of places where individuals can discover and study science in entertaining and exciting manners, including museums, scientific centres, and even online. These venues are referred to as informal learning environments. Many researchers in the past two decades have focused on the role of museums as learning institutions Shaby and Weiss (2020) in their case study focused on identity development as a product of interaction during visits of science museums. They suggested that flexibility should be provided to children while building their interactive experiences.

## Literature Review

In such an environment where families bring their children to explore, play, and learn about the world around them. These children as learners are flexible in their choices of visiting different places like science museums, zoos, botanic gardens, parks etc. or other informal learning media like television, social media sites, libraries and other hobbies. Bell and Lewenstein's (2009) study examined the connections between formal and informal scientific education, although it might not go in-depth into the requirements and experiences of primary school-aged children who are learning in informal environments. Studies that reviewed science communication and public involvement with science also reported similar findings. (Baram-Tsabari & Osborne, 2015; Jensen & Buckley, 2014).

Although learning science inside and outside the school environment is similar processes in learning science are the same. However, out-of-school experiences can bring a diversity of experiences as these can provide alternative ways for individuals to comprehend science outside of school. Similarly, participation patterns may differ due to demographic variables (DeWitt & Archer, 2017). A student's understanding of scientific concepts and processes can greatly benefit from these informal learning experiences due to cognitive outcomes relating to specific areas of science. In a study, Tang and Zhang studied the positive impact of informal science learning experiences on students' achievements along with students' interest in science learning and self-efficacy. Student satisfaction is greatly influenced by social interaction and the chance to interact with and learn from the surroundings (Brody, 2005; Tal, 2012).

The National Research Council (2009) also reported that the opportunity to engage in scientific reasoning is an important part of informal science learning. In a study of 41 families at a marine exhibit with touch tanks where the children and adults could explore, make predictions, and test hypotheses, Kisiel, et al. (2012) showed that scientific reasoning and meaning making involve the use of "tools and strategies for seeking and justifying knowledge" (p. 1048). In a comparable way, social experiences frequently occur in multigenerational groups that focus on their hobbies and knowledge of each member. The focus on excited discovery and hands-on interaction provides an opportunity to engage lots of people who may not otherwise think of themselves as knowledgeable or even curious about science.

Families are a major segment of visiting these informal sites of learning. Many researchers focused on intrafamily social interactions. Schauble et al (2013) investigated the parent's role in assisting children in the generation and evidence-gathering stages of collaborative scientific thinking while exploring dyadic interaction. They claim that while parents offered helpful support in various forms, it was worthwhile. They neglected to take advantage of crucial chances to assist children in interpreting the information, which stopped children from making some of the same comprehension advancements as their parents. Although opportunities to learn science in a specific sociocultural context are important for structuring their experiences most parents' and children's beliefs did not get more in line with one another.

The aim of this study attempts to add to the body of research on science education by exploring the experiences of primary pupils learning science in an informal context. Particularly at a primary school level, children are at an important stage in their cognitive development, when their curiosity and interest in the world around them are at their highest. This study attempts to investigate how informal science learning environments can improve students' engagement, attitudes, motives, and conceptual knowledge of science by focusing on the experiences of primary-aged students outside of the regular classroom setting.

Understanding primary children's experiences in informal science settings requires a comprehensive theoretical framework that recognizes the complex relationship of social, cultural, and cognitive aspects. Educators and researchers can obtain insight into the various ways students engage with scientific knowledge in informal environments by drawing on theoretical views such as epistemic cultures, contextual learning theory, constructivism, and socio-cultural theory. Using these theoretical frameworks, educators may create more successful learning experiences that encourage students' curiosity, creativity, and critical thinking skills in science.

Ash (2003) discussed a new approach for collecting data on family dialogue and the "inquiry process skills that advance or hinder dialogue". This researcher presented an innovative approach for gathering and examining family conversation information in museums and other informal environments. She focuses on dialogic inquiry within the zone of proximal development for families. Children develop an understanding of the topic through participating in an activity. Multiple routes of learning use each other and exhibit materials as scaffolds. Three constructs of understanding biological understanding of Exhibit:

**Personification:** A type of person analogy where children use humans as a model to predict the presence of characteristics in other living things (Carey, 1985).

**Essences:** Beliefs about the essential qualities of living things are among the modes of reasoning (Medin & Ortony, 1989).

**Functional Reasoning:** Children think that structures on living things are made for a reason because they use functional reasoning or a design stance (Ash, 1995).

In the Ash (2003) study, a description of three themes in which children's biological understandings may be grouped include 1) personification, where the human serves as the referent for a child's understanding of other living things; 2) essences, in which there is a belief that living things have a fundamental essence that does not apply to nonliving things; and 3) functional reasoning, which is the belief that structures on living things serve a specific purpose. In addition to these three primary themes, the study also included a fourth theme problem-solving and collaborative skills that is connected to a particular exhibit in the Nature Quest section of a community museum.

Informal learning spaces, such as zoos, scientific camps, and botanical gardens can provide unique possibilities to enhance student's comprehension and enthusiasm for science. Although traditional classroom environments are important in the transfer of scientific knowledge, these informal settings can provide interactive displays, practical experiences, and real-world applications that can improve academic science learning. Despite the possible benefits of informal science learning, there is a lack of information on what primary school children do in these settings. There is a lack of in-depth study that focuses on the specific experiences of children in these informal settings.

## Material and Methods

The methodology of the study was qualitative, and the objective was to figure out the different ways of meaning-making about a phenomenon, so micro-ethnography as a method of inquiry was selected. Children's interactive exhibits, in a community science museum in Atlanta (USA), were the focus of the study. Nature quest area exhibits of the museum and three interaction activities were selected for the study. Since videotaping was not allowed and interviews of parents and children were not possible due to constraints on time and place in this museum, all data was collected through direct observations of children and their families. Two primary sources of evidence; are dialogic talks between children and their parents and observation of interacting behaviors. Their dialogue and interactions with each other and the exhibits were also recorded as written field notes. Field notes on activities observed by the researcher in the nature quest exhibit are presented. The times that children and their families visited each activity or exhibit were also recorded. Data analysis through exhibit description, theme identification, and reflective notes.

## Results and Discussion

### Exhibit Description

The Nature Quest area for children at the museum contained interactive exhibits and live animal displays designed to both entertain and instruct children between the ages of 2 and 12 years of age. The exhibits included simulated ecosystems, such as marine and forest ecosystems, a large structure simulating an oak tree with a net ladder that children can climb, and a simulated archeological dig. The physical environment of the exhibit was more attractive to the children. The lighting, color, design, etc. was appealing to children and their parents. The museum staff were very cordial and available to help children and parents.

### Nature of Activities

Hands-on activities were scattered throughout all the different exhibits. It included a fixed microscope with specimens encased in Plexiglas so the children could move them under the microscope and view them on a small screen. Another activity included a small, cupped holder in front of a "magic" mirrored screen where a child places a wooden egg, and a video of a chicken emerging from an egg is activated and projected on the mirrored screen. If a wooden acorn was placed in the cupped holder, a video of a seedling growing into a large oak tree was activated. Field guides, "Be A Scientist" cards, and "Challenge" cards were available online for parents to download and bring to the museum, but none were provided at the exhibits. Brief explanations were provided at the different activity stations, but most of the exhibits were designed with the intention that children could explore them with free will.

### Family Profiles

Most of the families had two to three children with them. A diversity of people, including African American, Caucasian, and Asian, were present. Most families included a female parent or guardian with one or more young children. The average ages of parents were 40 or younger and very few families with both a mother and a father were present. A few children were present with their siblings.

### Observations of Activities

The researcher chose three different types of activities to observe in three different exhibit locations within the Nature Quest area. The researcher also observed two separate interactive activities in the same area. A brief description of each activity and its dialogic segments are provided below:

**Activity 1:** Plant Puzzle

**Theme Observed:** Functional reasoning

**Descriptions:** The first area observed was an activity table near the simulated archeological dig with a fixed wooden puzzle of the parts of a flowering plant and brief descriptions of the purpose for the parts including the roots, stems, leaves, and flowers. Notes were taken on the interactions of the children with the puzzle pieces and on the dialogue between the parents and children on interactions of exhibits. Mostly, the parents tried to explain the parts of the plant to the child and its reliance on the sun's energy.

**Reflective Note*:*** Although many parents tried to encourage meaning-making through questioning and explanation of the purpose of the different parts of the plant, the children showed more interest in selective parts. Thus, the focus of the parents was on the connection between activity and meaning making.

**Activity 2:** Egg and Acorn with "magic" mirror

**Theme Observed:** Essence and problem solving

**Descriptions:** The egg, acorn, and "magic mirror" activity is in the Clubhouse exhibit beside the microscope activity. The object of the activity was for the child to place either a white wooden egg that resembled a real egg or a wooden acorn into a small, cupped holder that was placed in front of a "magic mirror". Once the wooden egg or acorn was placed in the cup, the reflection of an object in front of the "magic mirror" changed to a video of the egg changing into a baby chick and the acorn gradually developing into an oak tree. The child works independently to observe a "living" creature appear right before their eyes and make the connection between the living organisms and the inanimate object they put in the cupped holder. Making this connection is one of the higher-order goals of the activity and thinking about life cycles is another goal.

**Reflective Note*:*** The children interacted independently in this activity with the objects and the mirrored screen.

**Activity 3:** Pulley and PVC Pipes

**Theme Observed:** Problem solving and Collaboration

Description: The third activity was the "pulley and PVC pipes" activity beside the simulated oak tree previously described. In this activity, children used a rope pulley to hoist plastic balls, the size of a softball, in a small bag upward to the top of a platform beside the top of the tree. The objective was for children at the top of the platform to place the balls in a PVC pipe attached to the wall so that the balls would fall into a series of "tunnels" on the wall below. These "tunnels" were movable (pieces of PVC pipe attached by magnets) on the metal wall so that different configurations could be made with the different sections in the pipe. Children could move the pieces of pipe freely to design how they wanted the plastic balls to fall and in what direction. Children interacted with both the exhibit and with other children. Although there were no direct references to science meaning-making, problem-solving, and collaboration skills were apparent as children worked together to retrieve their concepts about materials and manipulate them.

**Reflective Note*:*** This was the most popular activity in the Nature Quest area and was in such a place where most children spent most of their time.

**Activity 4:** Interaction with Ocean Exhibits

**Theme Observed:** Personification

**Descriptions:** The fourth activity was the ocean exhibit where different lives of the ocean ecosystem were exposed to the children, and they had to capture fish. In this activity, the objective was to interact with certain characteristics of different types of fish in the ocean. The analogies they had to make were about the various body parts of fish, i.e. their brain, skeleton, bones, etc. The children asked directions from their parents on how to capture the fish and they enjoyed the lighting of the exhibits and interacting with their parents in this exploration.

**Reflective Note*:*** This was the most interesting activity for the younger children in the Nature Quest area and the expression of their gestures showing elements of concentration, interest, excitement, fear, and enjoyment were very explicit.

**Activity 5:** Interaction with Soft Bricks Exhibit

**Theme Observed:** Functional Reasoning &Problem Solving

**Descriptions:** The fifth activity was the soft brick exhibit, where different bricks of different sizes were available for the children. They had to build the wall using soft bricks in each space and number. The task becomes interesting when they come to the end of the activity and know that a different size or number of bricks is required to finish the job. So, the children construct and deconstruct many times to get success. So, children also used different spaces to show their exploratory behavior for learning this scientific activity.

**Reflective Note*:*** This activity area was only for the younger children and located comparatively in a corner of the nature quest but still, children of all ages were showing interest in interacting with this exhibit as it created enjoyment and fun along with the learning. Only a few children showed the capacity to formulate different solutions to this problem.

The goal of this research study was to gain insight into the type of interactions that children have with various exhibits specifically designed for children's science exploration in a community science museum. Throughout these observations, it was evident that most children were having fun as they ran from exhibit to exhibit in the Nature Quest area. Thus, they can bridge their experiences in and out of the school environment. However, it was not as evident whether they were engaged consistently in science meaning-making. Problem-solving was most evident in the "Pulley and PVC pipe" activity near the oak tree exhibit. The "Pulley and PVC pipe" activity appeared to be the most popular in the Nature Quest area where most children spent most of their time.

Throughout the Nature Quest area, children spent 4 or 5 minutes at various activities, moving on to the next activity. However, some children revisited a few activities such as the "egg, acorn, and "magic" mirror" activity. These activities seemed to appeal to younger children ages 3 to 5. Initial findings indicate that most interactions were short and did not involve meaningful scientific meaning-making. One suggestion is for the museum to provide educational personnel in the Nature Quest area who could provide tours of the different activities and ask probing questions. That guidance can stimulate children's thinking about the different activities and reinforce science meaning-making. For example, if a child approaches the plant puzzle, the education personnel could ask questions such as "Why are plants important to us?" "What are some important things that plants do?" "Why do you think so many plants have roots?"

The child could still explore the puzzle but asking a few open-ended questions might get them thinking and help parents think about the right questions to ask as they go through the exhibits. A sample question sheet for the different exhibits could be given to parents as they enter the Nature Quest area. To determine if children are engaged in science meaning-making during their interactions in the Nature Quest area, more extensive observations are needed at each area and the live animal tanks. Videotaping the interactions of parents and children and recording the dialogue between them as they interact with the exhibits would provide more detailed data regarding science-meaning-making. Similarly, many attributes related to science learning like the context of engagement, meaningful communication, and continuous support for stimulating children's learning need more in-depth study design.

## Conclusion

Children’s interest and motivation were high throughout the interactions. Additional themes that emerged during the data analysis were Problem-solving and collaborative skills. Problem-solving was the most evident strategy in search of scientific knowledge. Mostly interaction experiences were brief and did not involve an in-depth scientific meaning-making process. The puzzling nature of exhibits creates the children to revisit that exhibit. Probing questions both from parents and children stimulate children’s thinking Museum.

## Recommendations

The focus of this research study was to add to the growing body of knowledge on informal science education and how it can raise students' interest in and knowledge of science. Educators and policymakers can enhance the scientific curriculum by adding more experiential and hands-on learning opportunities, which will enrich students' educational experiences and develop a love of science. The education personnel can provide tours and answer probing questions to stimulate children’s thinking. Sample question sheets for parents may be provided. It can help them scaffold their children’s concepts. It was a time-consuming study and needed extensive time for observation and multiple visits to understand meaning-making. The study's conclusions are anticipated to impact science education stakeholders, educators, and legislators by emphasizing the value of incorporating non-formal learning opportunities into formal curriculum frameworks and ensuring that all students have equitable access to high-quality science education. So, there is a need to focus on understanding the differential needs of children and exploring the reasons for differences in interaction with different exhibits. Future researchers can focus on process rather than content.

**References**


Archer, L., Godec, S., Calabrese Barton, A., Dawson, E., Mau, A., & Patel, U. (2021). Changing the field: A Bourdieusian analysis of educational practices that support equitable outcomes among minoritized youth on two informal science learning programs. *Science Education, 105(1)*, 166-203.

Ash, D. (1995). Preschoolers' understanding of biological causality: The child as naive theorist. *Merrill-Palmer Quarterly, 41(2),* 130-154.

Ash, D. (2003). Dialogic inquiry in life science conversations of family groups in a museum. *Journal of Research in Science Teaching.40(2)*, 138-162.

Bell, P., Lewenstein, B. V., Shouse, A. W., & Feder, M. A. (Eds.). (2009). Learning Science in Informal Environments: People, Places, and Pursuits. *The National Academies Press*.

Baram-Tsabari, A., & Osborne, J. (2015). Bridging science education and science communication research. *Journal of Research in Science Teaching, 52(2),* 135-144.

Borun, M., J. I. Dritsas, N. E. Johnson, K. F. Peter, K. Fadigan, A. Jangaard, E. Stroup, andA. Wenger. 1998. Family Learning in Museums: *The PISEC Perspective*. Association of Science-Technology Centers.

Brody, M. (2005). Learning in nature. *Environmental Education Research*, 11, 603–621.

Carey, S. (1985). Conceptual change in childhood. Cambridge, MA: MIT Press.

DeWitt, J., & Archer, L. (2017). Participation in informal science learning experiences: The rich get richer? *International Journal of Science Education, Part B, 7(4)*, 356-373.

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

Hofstein, A., & Rosenfeld, S. (1996). Bridging the gap between formal and informal science learning. *Studies in Science Education, 28*, 87-112

Jensen, E., & Buckley, N. (2014). Why people attend science festivals: Interests, motivations and self-reported benefits of public engagement with research. *Public Understanding of Science, 23(5)*, 557-573.

Kisiel, J., Rowe, S., Vartabedian, M. A., Kopczak, C. (2012). Evidence for family engagement in scientific reasoning at interactive animal exhibits. *Science Education*. 1047- 1070.

Medin, D. L., & Ortony, A. (1989). Psychological essentialism. In S. Vosniadou & A. Ortony (Eds.), *Similarity and analogical reasoning* (pp. 179-195). Cambridge University Press.

National Research Council. (2009). Learning science in informal environments: *A review of the research. National Academies Press*.

Shaby, N., & Vedder-Weiss, D. (2020). Science identity trajectories throughout school visits to a science museum. *Journal of Research in Science Teaching, 57(5),* 733-764.

Schauble, L., Beane, D. B., Coates, G. D., Martin, L. M., & Sterling, P. V. (2013). Outside the classroom walls: Learning in informal environments. *In Innovations in learning* (pp. 5-24). Routledge.

Tal, T. (2012). Imitating the family visit: Small group exploration in an ecological garden. In E. Davidsson & A. Jakobsson (Eds.), Understanding interactions at science centers and museums—A sociocultural perspective (pp. 193–205). Boston, MA: Sense Publishers.

Tang, X., & Zhang, D. (2020). How informal science learning experience influences students' science performance: a cross-cultural study based on PISA 2015. *International Journal of Science Education, 42(4),* 598–616.