

THE ROLE AND FUNCTIONS OF SCIENTIFIC AND RESEARCH MUSEUMS AROUND THE WORLD

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Abstract: This article explores the significance of museums, particularly science museums, in the context of modern informal education. It demonstrates that science museums serve as effective tools for visualizing the history of science through exhibits, promoting interactive learning methods, and enhancing scientific literacy. Furthermore, the article highlights the importance of expanding the role of museums as centers for scientific and pedagogical research and emphasizes the transformation of visitors into active participants through interactive exhibitions, science fairs, laboratory equipment, and technological experimentation zones.

Keywords: museum, global experience, science and experimental museums, educational and pedagogical activity, science, industrial and technological development, tangible and intangible heritage, conceptual model, International Council of Museums (ICOM), integrated science education programs, interactive zone, exhibition.

Introduction. Museums are significant social institutions that serve educational and cultural-enlightenment purposes by collecting, preserving, and displaying material and intangible heritage related to humans and their environment. They offer an alternative educational environment that enriches formal learning and provides an open and continuous learning space for individuals of all ages. Museum education, organized on scientific and pedagogical foundations, enhances the cultural and educational roles of museums.

The theoretical basis of this field includes approaches such as constructivism, the theory of multiple intelligences, and the holistic model of communication. A common feature of these approaches is the emphasis on the individual needs and abilities of the learner or visitor, placing them at the center of the learning process. This makes museums an integral and dynamic component of the modern education system. [1, p. 50–53]

It should be noted that in today's world, museums play a crucial role as informal learning spaces. This learning process is often voluntary and shaped by visitors' personal interests. Learning in museums occurs within personal, physical, and sociocultural contexts. [2] While the personal context determines the level of motivation, the physical context—through exhibits, displays, and the environment—facilitates knowledge acquisition. The sociocultural context, which reflects the social connections between the visitors and the institution, is a critical yet underexplored factor. [3]

Unfortunately, traditional didactic approaches often fall short in such settings. [4] Therefore, modern and interactive pedagogical methods are increasingly necessary to enhance student engagement in museums.

In particular, boosting young people's interest and participation in science has become a pressing issue. [5, p. 1364–1384] Factors such as the content of science, self-confidence,

perceived value, and the weak connection between science and real life serve as significant barriers. Informal learning environments, especially museums, are recognized as effective tools to increase students' interest in science, enhance motivation, and strengthen the link between science and personal experience. Furthermore, considering the unequal distribution of science capital, museums can play an essential role in promoting equity and expanding access to science.

Materials and Methods. In modern science education, scientific literacy encompasses not only understanding key scientific concepts but also recognizing scientific inquiry and research as integral to human activity. [5, p.19] One effective way to achieve this broader understanding is through teaching the history of science. Researchers have emphasized that engaging with the history of science plays a vital role in developing scientific thinking in students.

Science museums hold a unique position in this process as they vividly convey concepts related to the development of science and philosophy through historical collections. These institutions also create environments that encourage active interaction with exhibits, thereby increasing students' intrinsic motivation and interest.

Science museums present scientific and technological developments to the public, contributing to the improvement of knowledge and practical skills. They showcase achievements in science, industry, and technology while illuminating the historical stages of development in these fields. Thus, science museums are becoming an essential part of the educational process.

These museums are accessible to children, adolescents, and families, serving as engaging gateways to the world of science and technology. Science museums stimulate curiosity about science, amaze visitors, and provide opportunities for independent experimentation, making the learning process interactive.

Science museums are an integral component of informal education. They familiarize young people with fundamental scientific principles and research methods while enhancing their critical thinking and analytical skills through active participation.

It is important to note that such institutions play a crucial role in easing economic, social, cultural, and technological adaptation processes and in fostering the general educational culture of citizens. Science museums not only demonstrate modern technologies but also allow visitors to experiment with, use, and explore them directly—distinctly setting them apart from other types of museums. [7, p.12]

Educational activities within museum environments complement formal school education. They provide opportunities for student interaction, idea exchange, formulation of research questions, and development of observation and data collection skills. Therefore, integrating museum visits systematically into school curricula is essential.

Moreover, hands-on experiences in museums offer important learning opportunities for students. [8] School excursions—especially to science museums—can serve as effective and innovative means for practical science education. However, as informal learning environments, museums offer limited guidance from teachers.

Learning based on students' natural curiosity not only leads to deeper understanding but also supports the application of scientific research processes in real contexts. Integrating excursions into classroom learning ensures targeted visits, and the information obtained from museums is further developed in class.

This study proposes developing a conceptual model that supports learning in museums to organize this process effectively. The model is based on three main goals: developing conceptual understanding, introducing scientific practices, and strengthening personal relevance.

Museums also offer a unique learning environment for children and their families to explore science and culture in informal settings. [9, p.62–67] They play a crucial role in cultivating interest in STEM (science, technology, engineering, and mathematics) fields from early childhood. Research shows that children begin engaging with science as early as preschool age through museums, zoos, and nature centers.

In the United States, there are over 1,100 science museums that annually provide excursions, educational programs, camps, teacher training workshops, and parent engagement activities for millions of children. Consequently, museums hold strategic importance in developing children's scientific literacy and cultural awareness.

Research conducted in museums intersects with fields such as science education, developmental psychology, anthropology, and museum pedagogy. These studies focus not only on learning outcomes but also on social interaction and personal motivation. Learning in museums is a multifaceted process involving cognitive, social, and emotional experiences rather than merely memorizing facts.

In recent years, increasing attention has been paid to the content of conversations between parents and children in museums and how these dialogues affect learning. [9, p.62–67] However, the specific role of parents in this process remains underexplored. In particular, further research is needed on the impact of parental questions and explanations in shaping children's scientific understanding.

Results. Research shows that detailed questions posed by parents help direct children's attention to key aspects and stimulate active cognitive processes. Especially important are "joint conversations," where children's responses elaborate on their parents' questions—these dialogues significantly enhance knowledge retention.

For instance, STEM-related concepts such as mass, velocity, or structural engineering become more comprehensible when discussed directly between parents and children. This interaction effectively supports children's understanding and recall of scientific concepts. Moreover, learning continues not only during the museum visit but also through follow-up conversations in daily life. Such extended learning processes—reflecting on museum experiences over time—lead to deeper comprehension and long-term knowledge consolidation.

Cultural context, parental education level, and prior museum experience influence the form and effectiveness of these conversations. Therefore, cross-cultural studies are essential to identify which types of parent-child interactions are preferred in different groups.

Future research should aim to identify conversation types that most effectively foster children's scientific literacy, communication skills, and meaning-making abilities. Additionally, experimental studies are necessary to test the theoretical models in practical settings.

In conclusion, parent-child conversations about science in museums positively impact not only immediate learning but also long-term knowledge development. A thorough analysis of such conversations could yield practical results for educational policy and learning environment design.

Today, museums are seen as important institutions of culture, knowledge, and public engagement. They carry out diverse functions, including preserving historical heritage, conducting scientific research, educating the public, and fostering cultural dialogue across

various groups. Balancing these functions requires strategic planning, financial stability, technological innovation, and inclusivity. [10]

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