

Children's Science Outreach Platforms through Informal Science Education: A Scoping Review with a Focus on Iran

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Abstract

Purpose: Informal science education is a prerequisite for successful science outreach; without it, the effectiveness of outreach programs diminishes. This study aimed to identify effective informal education platforms for promoting science among children and to evaluate Iran's engagement within each platform.

Methodology: A scoping review was conducted following Arksey and O'Malley's five-stage framework. A systematic search identified and selected 31 relevant sources for analysis.

Findings: The analysis identified seven primary platforms for children's science outreach: (1) Organizational Coordination, (2) Events and Exhibitions, (3) New Technologies, (4) Nature-Based Experiences, (5) Interdisciplinary Science-Art Programs, (6) Family Participation, and (7) Direct Involvement of Scientists.

Conclusion: In Iran, despite valuable institutional efforts, science outreach activities remain fragmented. Platforms combining science with art and those involving the direct participation of scientists have received less attention. The establishment of national programs, support for interdisciplinary projects, and the cultivation of networks among scientific institutions could enhance coordination and expand the impact of children's science outreach across the country.

Value: This research provides a valuable mapping of effective global platforms and a critical analysis of Iran's position within them. This enables evidence-informed policymaking for national science outreach development. The findings can guide educational, cultural, and research institutions in designing participatory, interdisciplinary, and creative programs to advance children's scientific literacy.

Keywords: *Active Children's Participation, Science Outreach Activities, Scientific Literacy, Informal Science Education, Scoping Review.*

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Extended Abstract

Introduction: Informal science education refers to structured learning activities that occur outside the formal school system (Sefton-Green, 2012). These activities may take place in settings such as museums, science centers, and aquariums, or through digital media platforms (Rautela, 2023). This concept has emerged as an effective complement to formal education, offering more flexible and engaging opportunities for science learning (Bell et al., 2009; Bathgate, Schunn, & Correnti, 2014). In contrast to formal education, which is grounded in standardized curricula and structured assessments, informal education is driven by learner curiosity, interaction, and self-exploration (Hein, 2009). It is typically inquiry-based and experience-oriented, fostering intrinsic motivation and promoting long-term engagement with science (Stocklmayer, Rennie, & Gilbert, 2010; Falk & Dierking, 2019). Morrow (2004) emphasizes that informal science education is essential for effective science communication, arguing that a lack of such environments weakens the impact of outreach efforts. The integration of formal and informal learning experiences is key to enhancing children's scientific literacy. Purposeful informal learning can compensate for the limitations of formal education by nurturing curiosity, cultivating positive attitudes toward science, and preparing children for a knowledge-based society (Hinojosa et al., 2021).



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Purpose: This study examines the potential of informal science education to enhance children's engagement with science and technology. While limited studies exist in the Iranian context, a systematic, comparative analysis is lacking. Therefore, this study aims to identify the key informal learning platforms used globally for children's science outreach and to evaluate Iran's current position and engagement within this international framework.

Methodology: This study employed a scoping review methodology based on the five-stage framework proposed by Arksey and O'Malley (2005). The process involved a systematic and iterative search strategy using relevant keywords in both Persian and English. International literature was sourced from databases including Scopus, Web of Science (WoS), Google Scholar, and ScienceDirect. Domestic (Iranian) literature was sourced from Magiran, Noormags, ISC, and IranDoc. To enhance transparency and methodological rigor, the PRISMA-ScR framework was followed. Following a two-stage screening process (title/abstract and full-text), 31 studies met the eligibility criteria and were included in the final analysis. Data extracted from these studies were analyzed and thematically synthesized to answer the research questions and map the key thematic domains.

Findings: Based on a scoping review of 31 domestic and international studies, this research identified seven primary informal education contexts used globally to promote science among children: (1) Workshop-based activities in museums, libraries, and science centers; (2) Public events, exhibitions, and science festivals; (3) The application of digital and multimedia technologies; (4) Nature-based exploratory experiences; (5) Integration of science with art, crafts, humor, and entertainment; (6) Family-centered participation programs; (7) Direct interaction between scientists and children.

Qualitative analysis revealed that successful global models emphasize interactive, experiential design and incorporate play, humor, and storytelling. A

common feature is the prioritization of children’s active participation as the core of the science learning process.

Regarding the Iranian context, the results indicate that despite valuable initiatives by institutions such as the Center for Intellectual Development, science museums, and scientific associations, outreach programs are often fragmented, short-term, and lack coherent national policy support. Figure 1 illustrates these seven major outreach platforms, with examples from Iran showing uneven development. While workshops are relatively common, platforms integrating science and art, facilitating family involvement, and enabling direct scientist-child interaction have received less attention. Furthermore, a lack of sustained collaboration among educational, cultural, and research institutions was identified as a key barrier to expanding informal science education in the country.



Figure 1: seven major platforms for children’s science outreach.

Conclusion: Despite existing promising examples, science outreach activities in Iran remain fragmented, institutionally isolated, and lack a coherent national strategy. Many programs continue to rely on a one-way transfer of information rather than embracing interactive, inquiry-based, or participatory learning methodologies. To address these gaps, institutions such as libraries and schools must move beyond their traditional roles and transform into dynamic hubs for hands-on science exploration. Achieving this transformation in the Iranian context necessitates the formulation of coordinated national policies, dedicated support for interdisciplinary projects, and the strategic use of media, technology, and art to present scientific concepts in engaging and accessible ways. Consequently, strengthening collaboration

among schools, universities, and cultural institutions to create an integrated network of informal science education centers represents a critical step toward fostering a sustainable culture of science and enhancing scientific literacy among children. Ultimately, the findings of this review affirm that informal science education should not be viewed as a peripheral activity but rather as a strategic and essential component of effective science outreach and holistic child development policy.



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Value: This research provides significant insights for both policymaking and practice by mapping effective global platforms for children's science outreach and critically analyzing Iran's current position within this landscape. The findings offer an evidence-based foundation for developing informed national science promotion policies. Furthermore, the results provide practical guidance for educational, cultural, and research institutions to design collaborative, interdisciplinary, and creative programs that effectively advance children's scientific literacy.

Specifically, the study makes two key contributions: (1) It highlights the critical need for institutional synergy among museums, universities, NGOs, and families to transition from isolated, short-term projects to a sustained, coordinated national effort. (2) It underscores the strategic importance of currently underutilized approaches—particularly the direct participation of scientists and the integration of science with the arts— as high-impact domains for cultivating positive attitudes and deeper engagement with science among children.

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