COMMENTARY

Science Education beyond the Classroom: Out-of-School Learning Environments and Implementation Challenges

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"Science is a way of thinking much more than it is a body of knowledge,"
- Carl Sagan

OUT-OF-SCHOOL learning environments (OSLEs) include all educational settings and scenarios outside the realm of formal schooling. As opposed to structured, compulsory, and subject-based school education, out-of-school learning is characterized as nonsequential, self-paced, and voluntary, emphasizing the construction and transfer of knowledge through real-world problem-solving (Falk, 2001). Specifically, OSLEs span science and technology centers, museums, nature conservation bases, community-based science centers, home education scenarios, all sorts of virtual educational spaces and more (Eshach, 2007; Yildirim, 2018). They share common features including providing learners with direct access to authentic objects, opportunities for experiential learning, and possibilities of generating personalized understanding in a free-choice atmosphere.

Under the current science education system, out-of-school learning is not simply an dispensable enrichment but an essential complement to the formal curriculum. In the authentic contexts provided by OSLEs, abstract scientific concepts become concrete, knowledge from textbooks establishes substantive connections with students' life experiences, and the gap between learning in school laboratories and genuine scientific practice is successfully bridged (NRC, 2009). At the same time, OSLEs can powerfully catalyze students' scientific interest and attitudes. Through low-risk exploratory experiences, they help learners develop an emotional connection with science, with distinctive effects in alleviating "science anxiety" (Falk & Dierking, 2010). Furthermore, OSLEs can act as transmitters linking formal education to popular cultural resources, facilitating the transfer of scientific knowledge to everyday life.

Effective out-of-school science education requires a systematic framework for activity design. Certain researchers argue that to fully realize the objectives of out-of-school learning, it is imperative to ensure thorough planning for the entire process, including the pre-trip, during-trip, and post-trip stages (Yildirim, 2018). For the preliminary preparation stage (before the trip), the teacher should establish explicit connections between the out-of-school learning activity and school curriculum, clarifying the activity's objectives regarding conceptual mastery rather than merely treating it as an ordinary "visit experience." In the meantime, relevant basic knowledge and safety instructions must be delivered before the trip. For the implementation stage (during the trip), the teacher needs to design cognitively challenging task sheets or question-guided observation record forms, steering students towards inquiry-based participation to avoid the "interpreter plus passive visitors" model. To this end, a shift in the teacher's role, from a knowledge transmitter to a learning facilitator, and proper utilization of specialist guide service available in OSLEs are warranted. Also important is the consolidation stage (after the trip), where the teacher should direct students to practice connecting experience to concepts, organize presentations of out-of-school learning outcomes, and continue to deepen students' understanding of those meaningful questions in the classroom. Together, these processes form a complete pedagogical cycle of preparation-experience-reinforcement (Cox-Petersen et al., 2003). Assessment design should adopt more diverse devices, including student learning portfolios and journals, to examine process-based performance, as well as changes in student affective attitudes, given that traditional paper-and-pencil tests are often inadequate for capturing the characteristics of non-formal learning.

Despite the educational value of OSLE activities being widely recognized, their implementation in practice still face certain challenges. A portion of educators may simply equate them to recreational activities like a spring or autumn outing, compromising their role as a significant component of the curriculum. Another concern is that OSLE activity design often remains focused on one-way knowledge transmission, failing to truly tap into the OSLE's potential as a locale of inquiry. Additionally, certain researchers note that students, if not properly guided, can be easily distracted by the novelty of the OSLE, which may negatively affect the intended learning outcomes (Eshach, 2007). Issues like these indicate that the educational value of OSLEs has not yet been fully realized. As a result, exploring factors constraining the in-depth implementation of out-of-school learning and identifying barriers to its successful enactment, as well as their underlying causes, have become salient direction in science education research.

Science Education in Out-of-School Learning Environments: Views of Teachers and School Principals in this issue, as a piece of qualitative research, seeks to investigate the perspectives of science teachers and school principals on the value of OSLEs to science education. While most existing research concentrates on discussing the effects of OSLEs on students' science performance and their attitudes towards OSLEs, this study looks at them from a different angle, focusing on how school leaders and frontline teachers conceptualize, plan, implement, and evaluate out-of-school science learning. According to the study's findings, both science teachers and school principals affirm the significance of OSLEs for science education; meanwhile, their use in this domain remains constrained due to issues such as the teachers' insufficient knowledge of relevant regulations and legislation, low frequency of out-of-school learning arrangements, incomplete planning of OSLE activities (particularly the lack of post-trip reinforcement), limited methods for assessing their outcomes, and a misalignment in evaluation criteria between the teachers' process-focused approach and the principals' product-focused one (Yu, 2026).

References

Cox‐Petersen, A. M., Marsh, D. D., Kisiel, J., & Melber, L. M. (2003). Investigation of guided school tours, student learning, and science reform recommendations at a museum of natural history. Journal of research in science teaching, 40(2), 200-218. DOI: https://doi.org/10.1002/tea.10072

Eshach, H. (2007). Bridging in-school and out-of-school learning: Formal, non-formal, and informal education. Journal of Science Education and Technology, 16(2), 171-190. DOI: https://doi.org/10.1007/s10956-006-9027-1

Falk, J. H. (2001). Free-Choice Science Education: How We Learn Science outside of School. Ways of Knowing in Science and Mathematics Series. Teachers College Press.

Falk, J. H., & Dierking, L. D. (2010). School is not where most Americans learn most of their science. American Scientist, 98(6), 486. DOI: https://doi.org/10.1511/2010.87.486

National Research Council. (2009). Learning science in informal environments: People, places, and pursuits. The National Academies Press/USA.

Yıldırım, H. I. (2018). The impact of out-of-school learning environments on 6th grade secondary school students' attitude towards science course. Journal of Education and Training Studies, 6(12). DOI: https://doi.org/10.11114/jets.v6i12.3624

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