Learning Science in Informal Environments: People, Places, and Pursuits

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Book Review

Learning Science in Informal Environments: People, Places, and Pursuits

by

Philip Bell, Bruce Lewenstein, Andrew W. Shouse, and Michael A. Feder, Editors, Committee on Learning Science in Informal Environments, National Research Council

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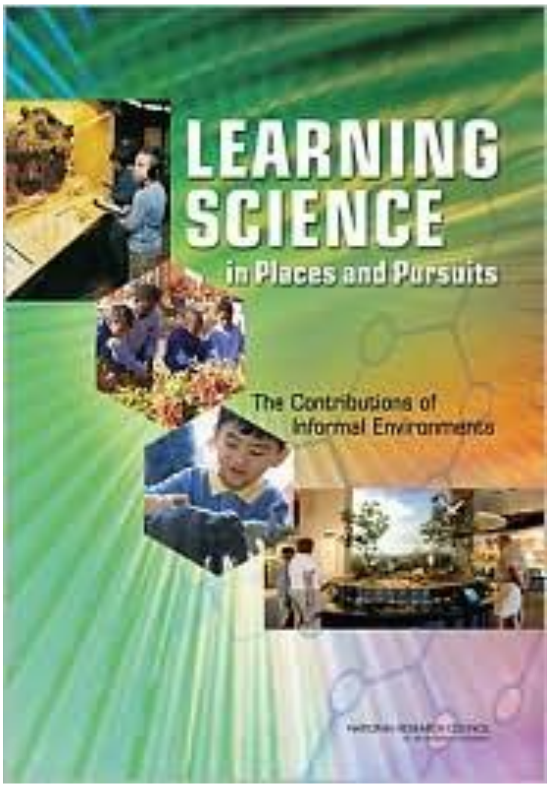

This United States National Research Council (NRC) committee report of a 3-year deliberative process of collecting and interpreting information that emphasized the last 20 years could be easily overlooked when environmental and science educators browse the titles in their libraries and web services. Unfortunately, that would be a mistake! This report—like other NRC reports on 'How People Learn' (2000) and 'Taking Science to School' (2007)—presents an in-depth, comprehensive overview of the state of knowledge about informal environments; it is a wealth of knowledge, ideas, and value-added insights about learning, resources, and assessment in settings beyond the 'bricks and mortar' schools.

Summary

The committee and editors have conducted a comprehensive systematic review of the literature and commissioned other position papers to supplement and address voids in the extant literature.

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The analysis and interpretation focused on six strands: Developing interest in science, understanding science knowledge, engaging in scientific reasoning, reflecting on science, engaging in scientific practices, and identifying with the scientific enterprise. These strands were used to organize the final report into four parts: chapters 1–3 set the focus, theoretical perspectives, and assessment; chapters 4–6 provide descriptions of the venues; chapters 7–8 explore the cross-cutting and emerging themes; and chapter 9 outlines the results and recommendations.

Chapter 1 provides an overview of the committee's perspectives, charge, and actions focusing on the problematic context of the science-technology focused metaculture of modern society. The curiosity- and mission-driven inquiries—both planned and unplanned—concentrate on personal hobbies, problems, pressing issues, and passions that produce specific knowledge and applications—not generalized theoretical understandings—and stand as desirable models for school science instruction with "the potential to bolster science education broadly on a national scale … [with the growing involvement in such events] echo[ing] the need for greater coherence and integration of informal environments and K–12 functions and classrooms" (p. 13).

Chapter 2 summarizes the competing theoretical perspectives for the 6 strands. The "narrow focus on traditional academic activities and learning outcomes is fundamentally at odds with the ways in which individuals learn across various social settings: in the home, in activities with friends, on trips to museums, in potentially all the places they experience and pursuits they take on" except schools (p. 27). The report recognizes life-long, life-wide, and life-deep learning and the significant contributions that lived experiences make to formal learning within integrative views of knowledge and learning, which combine cognitive and sociocultural theories, ontological and epistemological factors, and ecological contributions across places and pursuits. These theoretical considerations result in the identification of people-centered, place-centered, and culture-centered lenses for learning.

Chapter 3 addresses the perplexing conceptual, ethical, and practical issues of assessment that reflect the variety of intentions, venues and learners, the voluntary nature of involvement, and the methods compatible with informal environments. The "standardized, multiple-choice test, [which] has become 'monoculture' species for demonstrating outcomes in the K–12 education system, is at odds with the types of activities, learning, and reasons for participation that characterize informal experiences" (p. 56). Most formal assessments are antithetical to self-directed learning, may threaten the participants' self-esteems, and may be unduly critical, controlling, and interfering with their intentions.

Chapters 4, 5, and 6 report on specific types of venues: Everyday settings and family activities, designed settings, and programs of young and old. The lines of demarcation amongst these settings and contexts are fuzzy and the distinctions within each are blurred. "In sum, although the nature and extent of science-related learning may vary considerably from one life stage to another, most people develop relevant capabilities and intuitive knowledge from the days immediately after birth and expand on these in later stages of their life" (p. 99). The amounts and exact ideas are not well documented, but they represent valuable resources of identity, prior knowledge, intuition, and informal reasoning on which to build further understandings, scientific processes, cognitive and metacognitive knowledge, and habits of mind in both formal and informal environments. Designed settings are fluid spaces to be engaged with episodically and navigated freely, with limited or no directions, guidance and facilitation by external scaffolding or staff to explore the target ideas emphasized by the design features. "Not surprisingly, experiences in these spaces are often designed to elicit participants' emotions or sensory responses to scientific and natural phenomena" (p. 128). Programs for young and old reflect societal changes in which more parents are working and requiring childcare, adults are seeking additional education to address career changes and leisure time, and seniors are healthier and inquisitive. After-school, weekend, and summer programs result in tensions with in-school programs. "The potential of programs for science learning is great, given the broader population patterns" and warrant careful consideration (p. 199).

Chapter 7 addresses the central issues of diversity, culture, and equity, including indigenous people. These issues are complex and interacting; they motivate many informal environments and opportunities and attempt to alleviate differential effects flowing from other educational systems and lack of opportunities. It is noted that "Environments should be developed in ways that expressly draw upon participants' cultural practices, including everyday language, linguistic practices, and common cultural experiences" (pp. 236-237).

Chapter 8 focuses on the role and influences of mass and interactive media in learning science (print media, education broadcast media, popular entertainment media, and immersive media—IMAX, planetariums, laser-projection systems). Media are used in various venues with varying degrees of success. "Science-related media are likely to continue to play a major role in the ways that people learn about science informally. The public often cites broadcast, print, and digital media as their major sources of scientific information" (p. 277).

Chapter 9 reports the committee's 18 conclusions and 7 recommendations. "Virtually all people of all ages and backgrounds engage in informal science learning in the course of daily life. Informal environments can stimulate science interest, build learners' scientific knowledge and skill, and—perhaps most importantly—help people learn to be more comfortable and confident in their relationship with science" (p. 291). Individuals and groups construct knowledge and conduct explorations that are influenced by their cultural-historical perceptions about the nature of science; their prior knowledge, interest, and identity are especially important in informal environments. Media, both independently and embedded in other venues, play important roles in learning about science. Informal environment designers and educators can and should make science more accessible, relevant, and considerate of diverse participants using community partnerships to enhance effectiveness and efficiency. Extra-curricular opportunities are becoming more common; and participants, facilitators, and mentors play critical roles in these informal environments. Assessment and outcome measures are problematic and valid evidence about these outcomes is somewhat evasive. Educators and researchers need to develop and share a common language, theories, and standards to build a more cohesive and instructive body of knowledge and practice. The committee recommended common and evidence-based design principles, community partnerships, and the development of tools and resources with iterative processes involving learners, educators, designers, and experts. Front-line staff should integrate participants' and their own questions, common language, ideas, concerns, worldviews, and histories. Extant knowledge and findings on informal environments about cognitive, affective, and sociocultural learning should be integrated; the resulting theories that span venues, ages, and goal-strands and the research results should be published more in peer-reviewed outlets.

Closing Remarks and Reflections

We were surprised, but pleased, to encounter this report midway through our independent systematic review of environmental and science learning and education research in informal settings. Our shared interest in science literacy that results in fuller participation in the public debate about science, technology, society, and environment issues leading to informed decisions and sustainable actions (Yore, Pimm, & Tuan, 2007) led us to locate, summarize, and react to the extant research literature on informal environments reported in recent journals (1990–2009). We base our remarks on and reflections of this book on our composite insights developed over the last 3 years of research sponsored by the Natural Sciences and Engineering Research Council, Canada and on our learning and teaching experiences in and with informal environments.

We found this book to be extremely useful in accessing and organizing the existing research results and, more importantly, identifying the existence of unaddressed issues and research voids. The committee commissioned position papers and additional research reviews on some of these voids, which are well worth accessing from the web addresses provided. We will try to mention some of the many strengths of this report and will outline some of the ‘it would be nice’ issues for further consideration by the *International Journal of Environmental and Science Education* readership.

First, many of the results, conclusions, and recommendations reported in this book are equally applicable to environmental, science, social studies, and mathematics education within and across formal education settings. The report highlights a paradox in environmental and science education regarding the engagement of inquiry and acquisition of reasoning skills where many adults are less inclined to engage in explorations and less proficient than their children in reasoning skills and science processes. This is also true in elementary and middle schools where teachers are reluctant to engage science inquiry and constructivist approaches while their students are super keen to explore these naturally occurring events. It is justly concluded that informal learning in everyday settings can provide a sound foundation for systematic investigations and building of knowledge, which can prove to be a valuable resource for moving toward equity in access to science. However, these experiences need to be coordinated with and utilized within the ongoing school program.

Second, the report condemns traditional ‘chalk-n-talk’ instruction, rote learning, and test-driven approaches, which are supported by other NRC reports and should provide guidance for reform efforts. Much science education instruction and research has been based on outmoded views of learning that do not fully incorporate learners’ prior knowledge and reasoning abilities about ideas and events (NRC, 2007). The report notes that “Students often have limited opportunities to understand or make sense of topics because many curricula have emphasized memory rather than understanding” (NRC, 2000, pp. 8–9). Informal and formal environments need to stress three key interactive-constructive principles: (a) people come to learning with prior conceptions about the world (natural and people-built) that must be engaged or challenged if new or refined conceptions are to be developed; (b) enhanced competence requires prior foundational knowledge, conceptual frameworks, and storage, retrieval, and application strategies; and (c) learning requires metacognition to be aware of, monitor, and control meaning-making and transference of learning to new situations.

The report does not focus on or emphasize the emotive elements that play a crucial role in learning in informal environments. In particular, the review of everyday settings seems to miss the fact that family has a strong emotive impact on children—an impact that can rarely be stronger in any other setting. Therefore, it is difficult to agree “that schools and science centers should learn from the authentic moments of curiosity and exploration seen in everyday learning—and try to recreate them in their settings” (p. 102) because the uniqueness of such settings is not possible to replicate.

Designed and people-built environments are in many ways trying to address the lost access to nature and natural environments once common to most people. More than 50% of the world’s population lives in cities, which means that a very high proportion of children have limited access to natural environments. In such situations, informal learning environments are important as they often function as ‘controlled replacements’ of inaccessible spaces. Elementary and middle school environmental and science education programs need to use experiences in such environments as the motivational force of the exploration phase of an in-school learning cycle where (a) the engagement phase is provided as a pre-visit introduction and (b) the elaboration, explanation, and assessment phases are provided as a post-visit consolidation and evaluation.

Third, the report acknowledges the assessment problems encountered in informal environments, which also prevail in constructivist environmental and science education programs. The normal measures for informal environments (attracting and holding powers, exit surveys, questionnaires, interviews) and other inferential measures do not provide sufficiently valid and reliable indications of conceptual, affective, procedural, and behavioral changes (summative *assessment of learning*) needed to assess the goals of informal environments, document effectiveness, and provide formative *assessment for learning* that empowers learners and informs designers of these experiences. There does not appear to be a shared perspective on assessment *for* and *of* learning within the informal environment community. The inherent unstructured nature, variable problem space, and flexible inquiries—where outcomes include broad ranges of behaviors and unanticipated outcomes are evident at different times occurring at different scales instead—add complexity to the assessment issue. However, these concerns are not dramatically different from the challenges faced in classroom instruction and educational research. The interesting potential for designed informal environments involving information communication technologies (video, audio, digital) are the electronic capture of very rich, complex, and unrestricted data and pathways through the informal environments. These data sources when paired with digital analysis systems for verbal, video, and digital data appear to be promising and allow efficient data mining within complex systems. Breakthroughs in the informal environments can provide leadership for the formal environments.

Fourth, the report appears to vacillate on a view of the nature of science; the choice of language did not make science fundamentally linked to people's curiosity. The emphasis appears to be on the expert level of science literacy and on scientific and technological careers rather than the citizen level of science literacy and the desire to promote fuller participation in the public debate about science, technology, society, and environment issues leading to justifiable decisions and sustainable actions. The authors went back and forth between science as something that is a part of everyday life and the idea that most people do not become formal or professional scientists, which appears to reflect the priority in the USA. However, we are all scientists as it is the basic nature of people to search for, describe and explain patterns of events in the natural world (Yore, Bisanz, & Hand, 2003). This feature of the report appears to be contrary to the central message about the nature of science promoted in most international science education reforms.

Fifth, unfortunately, this report does not elaborate on the concerns, barriers, and promises encountered by other minorities and the ontological and epistemological differences and similarities between traditional indigenous knowledge about nature and naturally occurring events (traditional ecological knowledge and wisdom, TEKW in Canada) and Western views of science and technology, the inquiry and design enterprises, and the knowledge systems flowing from these endeavors. The informal environments' concern for social justice and a leadership role within environmental and science education are important and well received and could do much to be a 'lighthouse' for addressing the engagement of non-dominant cultures' learning in mainstream science, technology, and environmental education.

Sixth, this report does not fully establish the concerns with media: journalistic versions of reports, editorials, video clips and sound bites; their commercial motives, audiences, and potential bias; and how they contribute to inaccurate views of science, certainty, time between initial findings and applications or cures (science-technology spectrum), and other features of scientific inquiry and technological design. Media are identified by people worldwide as major information sources for science, technology, and pressing science, technology, and society (STS) issues, socioscientific issues (SSI), and science, technology, society, and environment (STSE) issues. The literature review provided limited evidence of enhanced interest and perceptions of science and scientists but little evidence about understanding science knowledge, engaging in scientific reasoning, reflecting on science, and engaging in scientific practices. Much of the literature and research on these issues are found outside of the mainstream informal environments literature in the literacy and science literature (Pearson, Moje, & Greenleaf, 2010; Phillips & Norris, 2009; Webb, 2010; Yore, et al., 2003).

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