



THE CONCEPT OF DOSAGE IN ENVIRONMENTAL AND WILDERNESS EDUCATION

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Various stakeholders interested and engaged in environmental education, from program practitioners to funders to policymakers, often ask about the ideal “dosage” for achieving programmatically related goals, particularly in relation to developing and maintaining environmental literacy. Frequently, those stakeholders ask questions such as whether a program should be two or five hours in length, or whether a residential program should be two or five days long for maximum effectiveness. Other times, stakeholders frame questions around layering of experiences, asking: How many environmental education experiences are needed to create environmentally literate youth, or what kind of environmental education experiences are optimal to combine, in what order, and in what ways?

Responding to such dosage-related questions, however, is challenging for a number of

reasons. First, many variables contribute to successfully achieving desired programmatic outcomes, such as the range of program characteristics as well as students’ prior experiences, knowledge, and motivations, among others. Moreover, all experiences, including environmental education programs, occur within a context comprised of a myriad of sociocultural considerations. Dosage implies stability, yet learning and behavior occur within dynamic systems.

Second, dosage assumes equality of factors, supposing that entry conditions, learning, and outcomes are the same across participants. In reality, those aspects vary wildly for each participant. Third, most environmental education programs strive to achieve a range of outcomes and outcome types, from environmentally responsible behavior to academically related outcomes to social and emotional learning competencies, among

others. However, being successful in one or more of those may be achieved through different experiences and dosages combined in different ways, with different intensities, and within different timeframes. Therefore, when asked by interested environmental education stakeholders, “What is the ideal ‘dose’ of programming?” the most appropriate and accurate response is usually, “It depends!”

Within this context of numerous factors and variables that influence the range of possible responses to such complex questions, we set out to explore the research terrain related to dosage. We sought to better understand the ways in which research in environmental education, as well as related fields, discusses dosage. We also were interested in examining whether patterns existed within the literature related to outcome effectiveness correlated with intensity, duration, repetition, or other conceptualizations of dosage. As such, this brief includes discussion points, thematic strands, and provocations structured around ways that researchers and practitioners in environmental education and related fields have engaged with notions of dosage and similar ideas.

In environmental education, dosage has a variety of meanings and conceptualizations. Practitioners and researchers, therefore, refer to dosage and related concepts using a number of different, but at times overlapping, terms and structures. Many use the term dosage to refer to the amount of time participants spend in specific programs. Others use it to describe the layering of programs within an organization or agency, such as when participants engage in multiple visits to the same site over time, or in activities with coordinated curricula and programming among partner organizations. An example would be those who attend several programs that different organizational members of a collaborative consortium host.

Our review addresses three primary terms that researchers and practitioners frequently use to refer to the concept of dosage:

1. Duration
2. Repetition or layering of experiences
3. Intensity level



Duration

Researchers and practitioners who consider the amount of time that participants spend in programs (such as one-hour, three-hour, or five-hour programs; one-day, three-day, or five-day programs) commonly use the term “duration.” Within this realm, studies suggest that shorter programs, such as one-day field trips, can be effective in increasing outcomes such as pro-environmental attitudes (Farmer, Knapp, and Benton 2007; Fremerey and Bogner 2015) and content knowledge (Fremerey and Bogner 2015). Programs that occur over longer time periods, such as four or five days, however, might be more effective when the desired outcomes relate to enhancing connectedness with nature (Liefländer et al. 2013), enhancing positive environmentally related values (Sellmann and Bogner 2013), and influencing sustained pro-environmental behaviors (Bogner 1998). In a comparison of three-day

versus five-day programs at the same residential environmental education site, researchers found that five-day programs were more effective than three-day programs in fostering short-term gains in students' stewardship, interest, and awareness scores. Three months after the experience, only students from five-day programs exhibited greater awareness, and there were no significant differences in stewardship and interest scores between the three-day and five-day programs students attended (Stern, Powell, and Ardoin 2008).

Questions around duration may initially seem relatively simple to measure and, consequently, it may seem straightforward to make recommendations and/or prescriptions related to them. Findings on mental health benefits of time spent in nature offer insight to the complexity of interpreting studies in this vein, suggesting the need for further research.

Bratman, Hamilton, and Daily (2012) cite Barton and Pretty's 2010 research review, which concluded that a dose of five minutes of nature activity, followed by a dose of one full day of nature activity, produced the greatest increase in self-esteem, while a dose of between 10 minutes and a half-day in nature produced the least nature-related benefits.

The relationship between dosage and environmental attitudes is also complicated. One study suggested that this relationship may be curvilinear. Researchers studying the effects of three organizations' nature outings, which ranged in length from one day to two days and two nights, found that youth's environmental attitudes did not increase after the nature experiences (Orren and Werner 2007). They discussed this finding in relation to other studies; one study found that five-day programs had greater positive impact on environmental attitudes than three-day programs (Shepard and Speelman 1986). In contrast, another found that a five-day program was more effective than a three-week program (Yoshino 2005). The latter finding is complicated by the fact that the program was an intensive wilderness trip. The researcher surmised that the wilderness trip's physical and psychological challenges may have increased along with the trip's duration; hence, the students on the longer trip may have developed negative feelings toward being outside and in nature. Orren and Werner (2007) concluded that, in order to be effective, brief programs, such as those of less than a week in duration, might need to address environmental attitudes more directly through activities that foster positive emotions toward nature.

Additional studies have indicated that programs may need to allow for longer or more frequent experiences in order to develop an affinity toward nature (see Ernst and Theimer 2011, for review). Such findings suggest that other elements, such as how different experiences layer and/or the quality of the program instruction, may represent key variables that affect aspects of what is considered a question of "dosage."



Repetition or Layering

Researchers and practitioners alike have long considered repeated exposure to educational content as a key element of strengthening, deepening, and retaining desired programmatic outcomes. Research on retaining information shows that listening to a description of a scientific phenomenon multiple times may enhance abstract learning as participants can recall conceptual ideas more than formal equations or analogies (Mayer 1983). In addition, research has shown that listening to one description produced similar recall results as repeated listening when the participants were also given, in advance of listening, a sheet with diagrams depicting the primary principles underlying the scientific law. These findings suggest that visual conceptual frameworks, in conjunction with a description of the scientific phenomenon, may be as effective as providing repeated oral descriptions. One should note, however, that this research tested recall and conceptual understanding immediately after the listening exercise; therefore, while recall may have been high at that time, retention in the longer term is unknown.

With regard to environmental education programming, researchers found that repeated exposure to wildlife performances, such as dolphin shows, were significant predictors of conservation-related knowledge and behavior both immediately following and three months after the show (Miller et al. 2013). Related research showed, similarly, that nature-based tourists who participated in wildlife interpretive experiences in a state park were significantly more likely to carry out environmentally friendly behavior if they were repeat visitors to state parks versus being first-time visitors (Wheaton et al. 2016). Other researchers have found mixed results with regard to the effect of repeated visits to nature-based tourism sites on participants' conservation knowledge, attitudes, and behavior (Hughes and Morrison-Saunders 2005; Ballantyne, Packer, and Falk 2011). Given that wildlife experiences, as well as the meanings people make from those experiences, are different from visit to visit, pinpointing what

aspects of an experience are related to increased pro-environmental behavior for repeat visitors is challenging.

Effective repeated, layered experiences might include pre- and post-experience aspects, especially given that research has shown that pre- and post-activities, when coupled with museum visits can augment learning (DeWitt and Storksdieck 2008). In environmental education, such pre- and post-experience aspects may include an educator from the forthcoming environmental education site visiting the classroom before and after a residential environmental education experience. Another option would be to add a short, targeted outdoor excursion before or after a classroom module; teachers might facilitate this by taking students to a nearby park or even simply to any open space on the school grounds. Other research has found that combining focused content, providing multiple experiences over extended periods of time, and coordinating with other experiences are effective strategies in promoting environmentally responsible behavior in the short, medium, and longer terms (Zint et al. 2002).



Intensity Level

The intensity level of a program, or the extent and degree to which environmental education content is included, also represents a key aspect of dosage. Programs that may have the same overall duration, but vary in intensity, may have varying, but distinct, effects on participants.

Building on behavioral-science principles, for example, researchers studied three types of schools in Israel to examine for differences in environmental attitudes and behavior following programming (Shay-Margalit and Rubin 2017). The first school had no special environmental curriculum. The second school was a “green” school, and the third school was a “persistent green” school. While both the second and third schools included requirements to reduce natural-resource use, had environmentally related curriculum content, and conducted an environmentally related community project, persistent green schools needed to

have enacted those requirements to a stronger degree in order to be distinguished as “persistent green.” The researchers found that, while both the green and persistent green programs had positive effects on environmental attitudes, only the persistent green program (which also included more environmentally related content as part of the curriculum) had a positive effect on environmental behavior.

Other researchers studying levels of program intensity have found that aquatic stewardship programs that include hands-on fishing experiences are more effective in influencing several antecedents to environmentally responsible behavior than programs that did not include such experiences (Siemer and Knuth 2001). Adapting a behavior-change framework from Knapp and colleagues (1997) that conceptualized how entry-level, ownership-level, and empowerment-level variables may predict behavior change, the researchers found that youth in the more intense program were more likely to consider human impacts on aquatic life and understand about aquatic habitats.



BOTTOM LINE FOR PRACTICE

Based on how researchers examine dosage and how practitioners, funders, and others stakeholders envision it, particularly with regard to nature-based and environmental education programming, the following implications for practice seem key when designing, researching, and implementing programs.

First, dosage is not a simple term with a single definition but, rather, it consists of dimensions of an environmental education experience or suite of experiences. Those dimensions include, but are not limited to, program length or duration, repetition or layering of experiences, and/or the intensity level or content of those experiences.

Second, stakeholders need to consider dosage in light of a program's goals. Competing goals, such as a long exposure to nature but under intensive conditions, may prove to be counterproductive in supporting attitudinal shifts. In another example, if the program aims to provide a memorable experience, then a single, powerful "wow" event or mountaintop experience might suffice. If the goal is to foster civic participation, however, then participants most likely need ongoing or repeated exposure to develop civic-engagement skills and participatory activities to build confidence and gain practice. It may be helpful for

a program to tinker with different dosages with the desired outcome goals in mind.

Third, unlike in the medical model from which the dosage term is derived, achieving an optimal level of exposure to an educational experience or a natural or wilderness setting will not look the same for each person, each desired outcome, or every type of program, again complicating this analogy.

Fourth and related to the above, how we understand dosage depends greatly on the outcome(s) that a specific program is seeking, as well as the program's and participants' sociocultural, political, and geographic context. Dosage needs to be considered in light of a participant's prior understandings and experiences as well as a participant's subsequent steps after a program. The optimal dosage for social and emotional learning outcomes, for example, may depend on multiple types of dosages rather than a single conceptualization, such as program length.

Finally, we may also assume that, given research on effective teaching and learning, fostering environmentally responsible behavior may occur in any length program. The most important aspect, then, is whether the program elements and activities are meaningful to the participants.



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