

Nature Walks as a Tool for Stimulating Learning Outside of the Classroom

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I conducted a pilot study on college students taking an introductory biology course. I explored the impact of instructing students about fungi and plant biology on a nature walk compared to teaching the same material in a classroom setting. Despite associated challenges of an outdoor environment, nature walk-based instruction was as effective as classroom-based instruction in terms of content mastered by the students. Additionally, the students receiving nature walk-based instruction reported more positive attitudes toward the material despite potential drawbacks such as distractions, temperature extremes, and disgust toward environmental stimuli. Thus, outdoor instruction should be considered a viable alternative to classroom-based instruction for any topic that references the natural environment.

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There has been increasing interest in how direct experience with natural environments affects social development, physical health, mental well-being, and learning (e.g., Bowler, Bowler, Buyung-Ali, Knight, & Pullin, 2010; Louv, 2008, 2012). The definition of what constitutes a “natural” environment can be quite variable, but Kellert (2009) offers an encompassing view of nature that includes both the natural world apart from human influence as well as human-impacted natural environments such as a park or lawn. In trying to understand why exposure to natural environments may be so important, Kellert (2009) observes that human evolution has historically occurred in response to stimuli from nature rather than from built environments. Stimuli from the natural environment may still offer modern humans subconscious cues for hunting and foraging opportunities as well as for places of refuge. Thus, humans have an ingrained need to experience biological diversity. Natural environments have a variety of different sensory experiences that cannot be replicated indoors (Rivkin, 1997). Natural environments are more restorative to directed attention than artificial or built environments, and walking in nature or being shown images of nature improves performance on tasks requiring directed attention and memory (Berman, Jonides, & Kaplan, 2008; Kaplan & Berman, 2010). Similarly, on walks through natural environments, participants experience decreased anxiety, rumination, and negative affect as well as increased working memory (Bratman, Daily, Levy, & Gross, 2015). Thus, the natural environment offers great potential as a tool for educators trying to find solutions for enhancing student learning.

Direct experience with natural environments improves attitudes and perceptions of nature in students of all ages (e.g., Ballantyne & Packer, 2009; Malone & Tranter, 2003; Thompson & Mintzes, 2010). Ballantyne and Packer (2009) note that teachers highlight hands-on learning, experiential learning, local context, and sensory engagement as instructional advantages of outdoor learning environments that are difficult to replicate in the classroom. Natural environments potentially emphasize experience-based learning over potentially less-effective teacher-directed learning. Despite the potential benefits to students of learning in the natural environment, educators typically do not take advantage of their local natural environments, and many children have lost access to natural spaces as play environments (Malone & Tranter, 2003). Much of this is due to fears of various forms of perceived dangers that cannot be controlled in the natural environment (Rivkin, 1997). Underutilization of natural environments could be due to perceived logistical issues and decreased instructional potential as well as negative perceptions of the environment as scary, disgusting, or uncomfortable (Bixler & Floyd, 1997; Kuo, Bacaicoa, & Sullivan, 1998). Louv (2008) views this as symptomatic of an increasing disconnect between people and the natural environment.

For topics in certain disciplines such as the life sciences, a guided walk through nature would seem to be an ideal instructional format for stimulating learning for all of the reasons discussed above. Additionally, a nature walk is an opportunity to give students direct experience with natural history, the observation of organisms in their natural environment. This is an area of knowledge that is key in stimulating student interest, but that has been largely

removed from the core biology curriculum as something lacking in modern theoretical relevance (Dayton & Sala, 2001). The present case study on college biology students demonstrates how a nature walk can function as a successful alternative to classroom-based instruction in terms of both student learning outcomes and attitudes.

Method

Participants

Fifty-three undergraduate students (32 female, 21 male) enrolled in an introductory biology laboratory class for majors during the spring terms of 2012 and 2013 participated in this study. Students were enrolled in four laboratory sections with no more than 20 students meeting together in a single class period. The students who enroll in this course are adults at least 18 years old working toward careers in biology, medicine, and education. I was the laboratory instructor for all students in the study.

Procedure

I employed a repeated measures design with all students receiving both instructional treatments: nature walk and in-classroom alternative. The lecture content for both instructional treatments was scripted so that the oral presentation of the information was identical. The presentation of the material lasted a total of 45 minutes. The material consisted of fungi biology and plant biology. These are topics that lend themselves to an outdoor experience and topics, based on my personal experience, that students traditionally show low initial interest in. All students were taught both sets of material. The order of the material could not be randomized since the course was multi-section with a standard laboratory syllabus defined for all instructors. Thus, fungi biology was taught the first week of the study, while plant biology was taught during the second week of the study.

As I conducted the lecture, the students receiving the classroom instructional treatment viewed slides of photographs that I had previously taken of fungi or plant specimens on campus grounds. The students receiving the nature walk instructional treatment were led on an outdoor walking tour of the same specimens viewed by the classroom students as I conducted the lecture. The nature walk occurred within short walking distance of the classroom building. To control for any order effects, classes were randomly assigned to receive either the classroom instruction or nature walk instruction first.

During the course of the study, students first completed a 10-question multiple choice pre-test on the material to be covered while in the classroom. This took approximately 10 minutes. I then lectured for 45 minutes to the students on the material either in the classroom or during the course of a nature walk. Finally, the students completed the same 10-question assessment as a post-test in the classroom. The post-test score counted for a grade in the class. After the post-test, the students answered a 20-item survey of attitudes adapted from Bauer (2008). For the attitude survey, students selected a value on a seven-point scale between two polar adjectives, in reference to how they felt about the instructional topic (either fungi biology or plant biology). The adjective pairs were randomized with respect to “positive” and “negative” adjectives on the left and right sides of the survey page to minimize response bias. The post-test and attitude survey took 15 minutes. Additionally, during the second week, the students provided open-ended responses to four questions comparing the perceived effectiveness of the instructional treatments, their most favorite and least favorite parts of the nature walk, and their preferred

instructional treatment. This took an additional five minutes. Given the repeated measures design, any subjects missing one of the two class periods or not completing all tests, surveys, and written response questions were excluded from the final analysis.

Data Analysis

I calculated difference scores (pre-test scores subtracted from post-test scores) to assess how much knowledge students gained in the classroom compared to the nature walk instructional treatments and used paired comparisons t-tests to analyze differences based on instructional treatments. Answers to the open-ended response questions were coded and summarized for comparison with the attitude survey data. An exploratory factor analysis (EFA) was conducted on the survey items following the procedural recommendations of Costello and Osborne (2005). I used repeated measures analysis of variance (rmANOVA) to determine if the attitudes differed between the nature walk and classroom instructional treatments.

Results

Data from 53 students who had completed all tests and survey items were used for the final analysis. A paired t-test found no significant difference in student performance difference scores between the nature walk ($M = 3.42, SD = 2.05$) and classroom instructional treatments ($M = 3.38, SD = 2.16$; $t(52) = 0.104, p = 0.459$).

Student answers to the open-ended response questions were coded and tabulated. Table 1 compiles data regarding student perceptions of the effectiveness of the instructional styles while Table 2 compiles data regarding student preference of the instructional styles. More students found the nature walks more effective than the classroom instruction (42 to 5) with six students not indicating one as more effective than the other. Similarly, more students preferred the nature walks to the classroom instruction (37 to 7) with nine students not indicating a preference. Students cited the hands-on nature of the nature walks and their ability to engage attention as two of the most common reasons for finding the nature walks more effective and preferring them to the classroom instruction. Several of the students who preferred the classroom instruction perceived it to be more understandable and organized and found it easier to take notes. Table 3 compiles data about the students' most and least favorite parts of the nature walks. Many students liked being outside and the hands-on aspect of the nature walks. However, specific aspects of being outside such as extremes in temperature, muddy conditions, and insects were listed as least favorite aspects. Walking or exercise was one item that was listed as both a favorite and least favorite aspect by students.

Table 1

Perceptions of Instructional Effectiveness

Reasons supplied	Nature walk more effective	Classroom instruction more effective
Total responding more effective	42	5
More hands-on or visual	33	-
Held attention	18	-
More detailed information	5	3
More understandable or organized	4	2
More novel teaching approach	2	-
Less distracting	-	1
Easier note-taking	-	1

Note. These data are comparison reasons given in response to open-ended questions about the effectiveness of nature walk vs. classroom-based instruction. Values indicate number of students out of 53 who gave that reason. Students could supply multiple reasons.

Table 2

Preference for Type of Instruction

Reasons supplied	Nature walk more preferred	Classroom instruction more preferred
Total responding more preferred	37	7
More hands-on or visual	16	-
Held attention	13	5
Fun	4	-
More novel teaching approach	4	-
Walking/exercise	3	-
More detailed information	2	1
Being outside	1	-
More understandable or organized	-	5
Easier note-taking	-	2

Note. These data are comparison reasons given in response to open-ended questions about the preference of nature walk vs. classroom-based instruction. Values indicate number of students out of 53 who gave that reason. Students could supply multiple reasons.

Table 3

Most and Least Favorite Aspects of Nature Walks

Reasons supplied	Most favorite	Least favorite
More hands-on or visual	21	-
Biodiversity of plants or fungi	13	-
Being outside	10	-
Application of knowledge	7	-
Seeing the unexpected	7	-
Memorable and exciting	3	-
Walking/exercise	3	7
Hot/cold/dampness	-	14
Distraction	-	9
Mud/dirt	-	7
Insects	-	4
Crowding	-	3
Taking notes outside	-	3
Walking in grass	-	3
Allergy	-	2
Organization (perceived lack of)	-	1
Witnessing harm to nature	-	1

Note. Values indicate the number of students out of 53 who gave that reason. Students could supply multiple reasons.

Exploratory factor analysis was used to study the patterns in the survey of student attitudes toward the classroom and nature walk instructional treatments. Most of the attitude survey items clustered into factors I deemed “Engagement”, “Clarity”, and “Comfort”. In addition, many of the items making up the factors were similar between instructional conditions; however, “unpleasant/pleasant”, “not challenging/challenging”, and “chaotic/organized” contributed to factors for the classroom instruction conditions only, and “tensed/relaxed” and “disgusting/attractive” contributed to the factors for the nature walk condition only. Because those items were not consistently seen in both treatments, they were removed from the analyses in which I compared the treatments on the Engagement, Clarity, and Comfort factors.

No correlations between the three factors and student performance on the post-tests were found to be significant; thus student attitudes on Engagement, Clarity, and Comfort were not related to their grades. Repeated measures ANOVA with sex as a between-subjects factor and instructional treatment as the within-subjects factor was performed on the Engagement, Clarity, and Comfort factors. For Engagement and Clarity, no significant effect was found based on sex, so the analysis was collapsed into paired t-tests. As seen in Figure 1, mean attitude positivity was significantly higher for the nature walk treatment than for the classroom treatment for both the

Engagement ($t(52) = -3.46, p < 0.001$) and Clarity ($t(52) = -1.77, p = 0.041$) factors. For the Comfort factor, rmANOVA found a significant interaction between sex and treatment ($F(1,51) = 5.655, p = 0.021$), but the main effects of treatment ($F(1,51) = 0.824, p = 0.368$) and sex ($F(1,51) = 0.336, p = 0.565$) were not significant. Women rated the Comfort items lower in the classroom treatment ($M = 4.73, SD = 0.75$) than in the nature walk treatment ($M = 4.89, SD = 0.98$), while men rated the Comfort items lower in the nature walk treatment ($M = 4.78, SD = 1.14$) relative to the classroom treatment ($M = 5.13, SD = 1.07$).

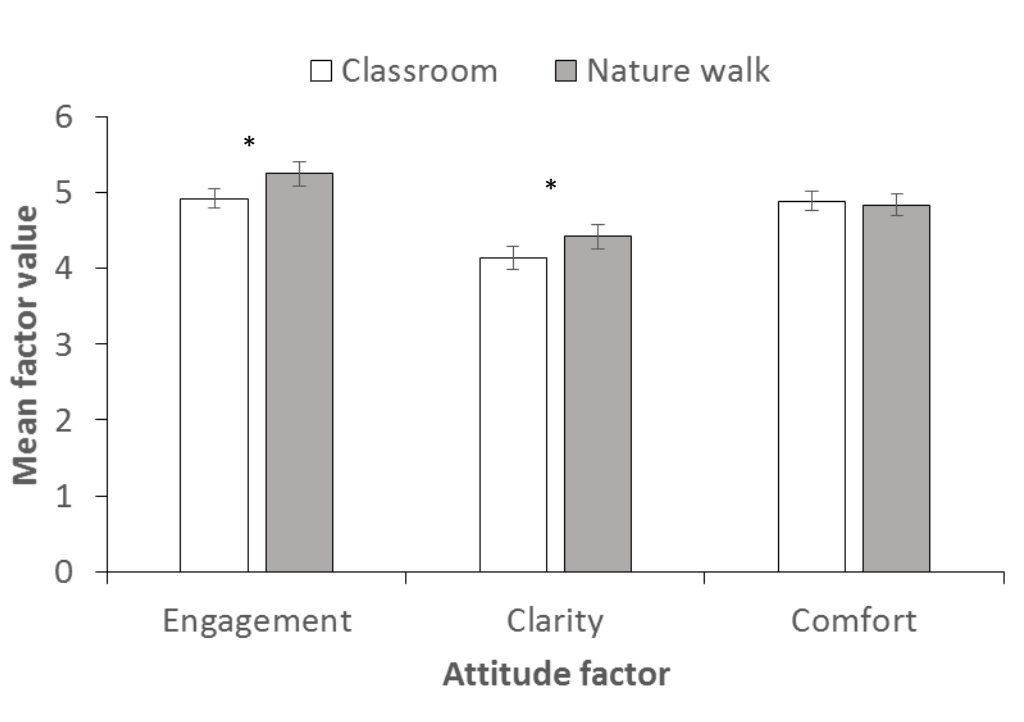


Figure 1. Comparison of classroom-based and nature walk-based instruction for the three best supported factors in an exploratory factor analysis of student attitudes. The factor values are equivalent to mean attitude positivity. Error bars indicate standard error of the mean. * indicates significant differences.

Discussion

Despite perceived drawbacks of taking students into a natural environment (e.g., Bixler & Floyd, 1997), the results of this case study indicate that guided nature walks are an effective alternative to classroom-based instruction for meeting student learning outcomes. Students learned equally well when taught material as part of a nature walk as compared to classroom instruction. Additionally, the students had more positive attitudes about the material when it was presented as part of a nature walk for two of the three factors (Engagement and Clarity) generated in the exploratory factor analysis. The change in the third attitude factor (Comfort) is more complex and is discussed below.

While instruction on a nature walk did not result in an increase in student test performance as might be expected from potential improvements in directed attention and working memory (Bratman et al., 2015; Kaplan & Berman, 2010), nature walks also did not result in a decrease in performance which might be expected due to drawbacks cited by the students in Table 3 such as distractions (temperature extremes, mud, insects, noise, etc.),

crowding by other students, and difficulty in taking notes. Indeed, despite these difficulties, a greater number of students found the nature walk more engaging and reported that it held attention better than the classroom-based slide show. Instruction on a nature walk is intrinsically a more sensory-rich experience than instruction in the classroom.

Ballantyne and Packer (2009) noted that one key advantage of education in a natural environment is the opportunity to emphasize experience-based learning over less-effective instructor-centered learning. In the current study, I employed instructor-centered learning in both the classroom and nature walk contexts. Specifically, I lectured in both situations and did not allow students to interject with questions to be as consistent as possible with the delivery of the content. Because of this, I did not take full advantage of the learning potential of alternative instructional strategies such as experience-based learning that are well-supported in the natural environment. Thus, the results obtained here may underestimate the potential value of nature-based instruction. It is also possible that just the act of students leaving the classroom and walking around, regardless of the potential effect of natural stimuli, affected student performance and attitudes. However, Hopkins, Davis, Vantieghe, Whalen, & Buccini (2012) found that a single bout of exercise just before a test did not affect memory and increased perceived stress. This would be similar to the 45-minute walk in the natural environment in the current study. Regular exercise was a much more reliable predictor of enhanced memory and mood (Hopkins et al., 2012). Thus, exercise alone cannot explain the results of the current study in terms of learning outcomes and attitudes.

In the current study, disgust toward mud or insects was noted by some students as a least favorite part of the nature walks. It might have been a more prominent concern had the nature walks occurred on the campus trail system rather than simply in the park-like grassy areas around the campus buildings. Bixler, Carlisle, Hammitt, & Floyd (1994) found that fear of organisms themselves, especially snakes, insects, other animals, and even plants is commonly reported as a negative aspect of student trips to natural areas. Students also report fears of getting lost and disgust in response to natural objects. The reasons for these negative reactions to nature are complex. Natural environments that are unfamiliar may promote fear and disgust responses (Bixler & Floyd, 1997). Pathogen disgust is elicited by stimuli that are potentially indicative of dangerous microbes and as such may be an adaptive defense mechanism against infectious disease or parasites (Cutis & Biran, 2001; Tybur, Lieberman, & Griskevicius, 2009). Fear of certain animals such as spiders may be a displaced disgust reaction to disease (Davey, 1994; de Jong & Merckelbach, 1998), while fear of other organisms such as venomous snakes, stinging insects, and poisonous plants may be an adaptive response due to past selection in response to pre-technological dangers (Bixler et al., 1994; Öhman & Mineka, 2003). Sensitivity to disgust varies from individual to individual (de Jong & Merckelbach, 1998), and these kinds of fear and disgust reactions need to be addressed in order to maximize the potential of nature experiences (Bixler et al., 1994).

In the exploratory factor analysis of attitudes toward the types of instruction, females rated the nature environment higher on the Comfort factor, while males rated the classroom environment higher on the Comfort factor. The Comfort factor included the items “dangerous/safe”, “insecure/secure”, and “uncomfortable/comfortable” for both the classroom instruction and nature walk treatments. These three items seem to focus on comfort in a safety sense. Indeed, in an urban context, Kuo et al. (1998) found that manicured areas with

trees and grass similar to the nature walk area used in the current study instill a sense of safety, although potential differences in this perception between the sexes were not examined. In the current study, for nature walk instruction alone, the “disgusting/attractive” item also clustered in the Comfort factor, so disgust may be more salient to students when they are actually present in the natural environment. Despite this, disgust must not have been the primary reason for this sex difference in attitudes toward the instructional environments. Based on the literature cited above, females might be expected to have less positive attitudes toward the Comfort items in the natural environment. Instead, females had less positive attitudes toward Comfort in the classroom environment. One possible explanation is provided by Kingma and van Marken Lichtenbelt (2015) who note that typical office buildings built since the 1960s (which includes the style of classroom building used in the current study) are calibrated for comfort levels matching male metabolic demand, and temperatures are not optimized for female comfort.

The participants in the current study were college students, and the results indicate how a teaching intervention (taking students into the natural environment), most typically implemented with younger grade school students, is still extremely effective for older students. In general, cultivating more positive attitudes toward a topic may positively affect retention in that course or area of study. Future work is needed to examine whether nature-based instruction has long-term impacts on knowledge retention, something that was not examined in the current study. Giving direct experiences with nature improves student attitudes, and in the long-term it may reduce fear and disgust reactions toward organisms and their environment (Bixler et al., 1994; Prokop, Özel, & Uşak, 2009). This is especially valuable for courses focusing on the environment and the relationship of humans to natural biodiversity. Identifying and working with students who have a heightened predisposition to nature disgust could help these students obtain more from their educational experience in the natural environment. Additionally, minimizing instructor reluctance to take students outdoors by promoting the effectiveness of nature-based instruction would help to reduce the current disconnect between students and the natural world.

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