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Enhancing college students' environmental sensibilities through online nature journaling

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The increasing alienation of today's children from the environment has been termed 'nature-deficit disorder'. Research suggests this disconnect can adversely impact young people's physical and psychological well-being. This paper explores whether online multimedia journaling about nature can increase the amount of time students spend outdoors, enhancing their environmental awareness and changing their nature-related perceptions. Students in a 60-person introductory environmental studies course at a large midwestern public university in the United States completed weekly online multimedia nature journals for one semester. A survey assessed their experiences. The median survey respondent spent an additional 11–20 minutes outdoors weekly. Seventy-four percent of respondents said that the project increased their awareness of nature, 68% said it changed the way they thought about nature, and 56% said it increased their interest in spending time outdoors. Though these findings are promising, there are some theoretical reasons for questioning their depth and duration.

Keywords: nature-deficit disorder; journaling; blogging; Net Generation; environmental awareness

Introduction

In *Last Child in the Woods*, Richard Louv argues that young people are increasingly disconnected from nature. From 1997 to 2003, the amount of time American children ages 9–12 spent on outdoor activities such as camping, hiking, and gardening dropped by 50% (Louv 2008). These youths are part of the 'Net Generation', a cohort born in or after 1980 (Bartlett 2005) whose members are increasingly filling university classrooms.

American youth ages 8–18 spend roughly 7.5 hours daily using computers, televisions, and electronic devices, plus an additional 1.5 hours texting and 0.5 hours using cell phones (KFF 2010). US college students use some type of media-accessing technology roughly 9.5 hours per day (Harris 2009). Net Generation members excel at multi-tasking, absorbing information quickly from multiple sources, and collaborating via networks (Prensky 2003).

This generation's nature alienation may pose dangers. Spending time in nature can reduce the severity of attention-deficit hyperactivity disorder symptoms and

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sharpen concentration (Faber Taylor, Kuo, and Sullivan 2001, 2002; Kuo and Faber Taylor 2004), increase self-esteem (Pretty et al. 2005), and reduce feelings of life stress (Wells and Evans 2003). Yet young people are increasingly losing out on such benefits.

This paper investigates the impact of college-level academic journaling about nature, an activity wherein students use the very technologies whose rise is correlated with their increasing environmental disconnect to construct multimedia essays documenting their perceptions of nature, analyzing environmental topics, and presenting scientific data. Can this practice increase the amount of time students spend outdoors, enhance their environmental awareness, and change their nature-related perceptions?

Literature review

Nature-deficit disorder and benefits of nature exposure

From 2006 to 2007, the amount of time American children ages 6–17 spent on outdoor activities fell 11.6% (Outdoor Foundation 2008). American children today spend about 50% less time outside than they did 20 years ago (US Forest Service 2010). Habits begun in youth persist in adulthood: Visits to public lands, issuance of game licenses, and evidence of time spent hiking and camping have consistently fallen roughly 1.2% annually in the United States since the mid-1980s (Pergams and Zaradic 2008).

This trend is troubling. When children with ADHD play in green outdoor spaces, parents tend to report reductions in symptom severity (Faber Taylor, Kuo, and Sullivan 2001; Kuo and Faber Taylor 2004). This finding is compelling because ADHD affects roughly 10% of American children (CDC 2010), many of whom are finding their way to university classrooms. Between 2% and 8% of today's college student population registers clinically significant ADHD symptoms (DuPaul et al. 2009).

When undergraduate students (as well as some employees and community members) at University of Essex were exposed while exercising to pictures of untrammelled natural areas, destroyed rural landscapes, or urban areas, those who viewed untrammelled nature scored higher on self-esteem metrics (Pretty et al. 2005). When 112 US undergraduates were divided into two groups, one taking a walk in a nature reserve and one taking a walk in an urban area, blood pressure improvements indicating reduced stress were more prevalent in the nature reserve group (Hartig et al. 2003). Members of that group also performed better on attentional tests administered during and following the walk (ibid. 2003). Wells and Evans (2003) examined parental ratings of psychological distress in 337 rural US children as well as the children's own self-worth ratings. Children with higher levels of nature near their homes appeared to experience less overall life stress. Ryan and co-authors (2010) evaluated the impact of time spent outdoors on the mental and physical energy levels of 171 undergraduates. The authors found that, all else equal, proximity to natural features significantly increases student energy levels.

Approximately 18% of American adolescents have a high body mass index (Ogden and Carroll 2010). Overweight adolescents have a 70% chance of becoming overweight or obese adults (US Department of Health 2007), joining the roughly 67% of American adults who already are (CDC 2009). Lack of physical activity

can contribute to overweight and obesity in young people (US Department of Health 2007), and can be linked to lack of nature exposure and high levels of technological connectedness. Cleland and co-authors (2010) found that among 421 children ages 5–6 and 10–12, those with ‘indoor preferences’, such as television viewing, spent significantly less time outdoors. Among 878 primary school students, low levels of physical activity could be predicted in part by students’ self-reported enjoyment of activities such as television viewing and computer use (Salmon et al. 2005). Research by Wells and Lekies (2006) suggests that the rate at which children participate in outdoor recreational activities significantly predicts the extent to which, as adults, they will view such pursuits favorably.

Nature journaling

Environmental education has long relied on journaling to encourage student reflection (Dyment and O’Connell 2003; Leslie 2001). Journaling:

...exist(s) somewhere on a continuum between diaries and class notebooks: whereas diaries are a record of personal thoughts and experiences, class notebooks are records of other people’s facts and ideas. Like the diary, the journal is written in the first person; like the class notebook, the journal focuses on academic subjects. . . .Each journal entry is a deliberate exercise in expansion: “How accurately can I describe this idea? How far can I take it?” The journal demands students expand their awareness of what is happening, personally and academically, to them. (Fulwiler 1980, 17)

Regularly documenting perceptions and observations about the natural world can help students better understand the ways they influence and are influenced by earth’s cycles (Leslie and Roth 2001). This practice builds a habit of environmental awareness students can integrate into daily life.

Scholarly literature generally finds journaling in the academic setting useful for helping students construct meaning from course materials, connect course materials with everyday life, pay attention to details, ask questions, and investigate answers (Cole 1994; Connor-Greene 2000). Academic journaling can encourage reflective thinking, foster writing skills, and encourage creative self-expression (Cantrell 1997; Connor-Greene 2000; Hammond 2002; Kerka 1996; Spaulding and Wilson 2002). The journals kept for the project discussed here were relatively private, shared only by the student and the instructor or graduate teaching assistant who graded them.¹

Online journaling

A growing literature examines the uses of blogging in higher education (e.g., Ellison and Wu 2008; Halic et al. 2010). ‘Blogging’ is essentially online journaling, an individual recording his or her thoughts on a webpage. Young people have dominated this activity. In 2004, 90% of bloggers were 13–29 years old (Nussbaum 2004). In 2006, 28% of American teens reported using a blog (Lenhart et al. 2010).

Students can include in their blogs hyperlinks to other web resources. Selecting suitable hyperlink material requires students to search the web for complementary information and develop criteria for sorting the data. This process builds relational knowledge and encourages critical thinking (Ferdig and Trammell 2004; Jonassen, Carr, and Yueh 1998; Stiler and Philleo 2003).

The archive format of blogs allows students to review previous writings easily and reflect on their intellectual growth (Williams and Jacobs 2004). Because blogging in the academic setting is novel, classroom projects using blogs may better pique student interest than traditional assignments (Ferdig and Trammell 2004; Huffaker 2005).

Stiler and Philleo (2003) assessed a project wherein undergraduates journaled using blogs. Content analysis showed that, relative to a control group of paper-and-ink journal entries, 'student entries on Blogger [a free blogging platform] were . . . more analytic and evaluative. . . Entries were longer and written in ways that indicated that students were considering the bases and motivations behind their beliefs rather than merely describing them' (Stiler and Philleo 2003, 795).

The project discussed here similarly used a blogging platform to encourage richer journal entries. Its online format easily allowed students to complement their writing with still and moving images. Generative learning theory indicates that when students link their verbal and visual information processing systems, they tend to engage in more creative and effective problem-solving and better comprehend educational materials (Mayer 1997, 2008).

Much of the academic blogging literature highlights as particularly valuable the ability of students to read and comment on one another's blogs (Churchill 2009; Ducate and Lomicka 2005; Ellison and Wu 2008; Leslie and Murphy 2008). Such interaction can facilitate the social construction of knowledge often linked to improved educational outcomes (Johnson and Smith 1991; Leslie and Murphy 2008). However, this project did not make students' blogs available to peers because it was introduced as a journaling activity. Journals often are private affairs intended for personal reflection, not public display. Mid-semester, I posed to students the idea of sharing the journals with classmates. In a subsequent anonymous evaluation, some students particularly noted that they wanted the journals to remain private.

Teaching the Net Generation

Eighty-four percent of American children ages 8–18 are growing up with regular home internet access. Seventy-five percent of college students have a laptop computer, 74% own an MP3 player, and 74% own a digital camera (Harris 2009). Sixty percent of college campuses are wireless, and this number is quickly climbing: two years ago, campus wireless coverage was at 30% (Harris 2009).

According to Barnes, Marateo, and Pixy Ferris (2007), Skiba and Barton (2006), Carlson (2005), Glenn (2000), Hay (2000), and Tapscott (2000), the Net Generation's technological saturation partly explains why its members often prefer autonomy in shaping their learning experiences; flourish with collaborative learning; value online education; enjoy investigative learning that requires them to pull information from many sources; embrace technological innovation; readily assert opinions; easily network; and reject delayed gratification. '[C]ollege students today not only multitask; they layer sensory experiences and communication avenues one atop another, moving between tasks and ideas quickly' (Wilber 2007, online). Prensky (2001, 2003) argues that the US education system poorly addresses Net Generation learning needs and must find innovative ways of accessing 'wired' learners.

One such innovation is to incorporate into class activities the technologies and associated learning styles students embrace. This project's online format met

students on familiar digital terrain, allowing them to switch among and layer concepts and media and personalize their communication. Students could complete journal entries as rapidly as they liked so long as they met pre-specified deadlines, after which journal entries were assessed using rubrics provided to students at the start of the course. This self-pacing component, as well as students' autonomy (within reasonable and legal boundaries) to choose the photos, sketches, video clips, and hyperlinks to include in their journals, was meant to align with their preference for learning autonomy. The task of mining multimedia elements from varied sources was intended to access students' identities as networked learners. Some journal prompts encouraged research; this dimension sought to engage learners' investigative enthusiasm. One student actually went to city hall, reviewed old property deeds, copied current and historical plat maps, and scanned and uploaded them to her journal. The project was specifically designed to access the affinities of Net Generation students.

The (digital) elephant in the room

I have been asked why students should use computers to learn about the environment. There are three answers.

First, one of an educator's biggest challenges is getting students to move beyond their intellectual and emotional comfort zones (Howell 1994; Korthagen 2005). Net Generation students appear increasingly unfamiliar with nature. Online multimedia nature journaling bridges the known and less-known. The project did not demand enormous amounts of time spent outdoors. It encouraged students to perceive positively the time they spent outside by analyzing their experiences using technologies they generally enjoy. Forging such an affirmative linkage is important given the literature which argues that when students respond positively to educational activities, they learn more deeply (Bryan, Mathur, and Sullivan 1996; Pekrun 1992; Sylwester 1994).

Second, Louv (2008) contends that young people's nature knowledge often focuses on topics, like rainforest destruction, which seem relatively distant from their lives. They are less likely to have gone hiking in nearby nature. Online multimedia nature journaling brings nature into students' everyday realities by channeling it through their omnipresent digital devices. A number of students reported that this project was one of the first times they had studied in detail their local environment.

Third, adolescents increasingly consider digital communication devices and online applications conventional mechanisms for constructing worldviews (Subrahmanyam and Greenfield 2008). It is sensible for educators to leverage that mode of thinking, using online activities to encourage offline learning.

Methods

Nature journal goals

- (1) Get students outside during the semester at least 15 additional minutes weekly.
- (2) Foster among students greater environmental awareness.

- (3) Challenge students' misconceptions about the environment, altering their thinking.
- (4) Enrich and reinforce classroom concepts.
- (5) Encourage students to spend more time outside in the future.

Nature journal procedures

Undergraduates in a 60-person introductory environmental studies course at a large midwestern public university completed online multimedia nature journal entries over one semester. The course was one of a small number whose completion would allow students to apply to a degree-granting program. Roughly 79% of students completing the final course evaluation ($n = 39$) said they took the class because it was required or conveniently scheduled.

The journals were hosted by Blogger, a free online platform. They were only visible to the instructor, graduate teaching assistant, and the student. Students completed 12 entries, analyzing the same natural site in each. Students picked their sites from a list of on-campus options or requested permission to journal about alternate sites. The sites were smaller than one city block.

I gave students all journal prompts and grading rubrics at the start of the semester. They had to meet weekly deadlines but could complete journals sooner. Students received feedback and grades weekly. Entries were collectively worth 25% of a student's grade, with each entry worth 1–2.5%.

Most prompts required writing. Nearly all required students to post digital pictures or create sketches and scan and post them as images. Some prompts required research. I told students that to produce quality journal entries, they should examine their sites carefully for at least 15 minutes, and then do additional work.² The prompts are available online at <http://www.gwenarnold.com/nature-journal-project>. Each prompt is complemented by an example of an actual high-quality student response.³

Survey procedures: evaluating the nature journal experience

Students were given an eight-item survey about the project at the start of the final class period and spent roughly 10 minutes completing it. The survey was administered per institutional review board requirements and was anonymous and optional.

Three questions asked respondents to choose an option on a Likert scale, two were wholly open-ended, and three asked respondents to choose a Likert scale option and explain. I used thematic analysis to code the open-ended responses.⁴

The response rate was roughly 83%. While the survey did not request demographic data, there were 39 males (65%) enrolled and 21 females (35%). Roughly 23% were freshmen, 48% sophomores, 18% juniors, and 10% seniors. The average final grade was a B- (see Tables 1 and 2).

Results and discussion

Students spent more time outside

The project appears to have met its goal of getting students to spend an additional 15 or more minutes outside weekly. The median respondent reported spending 11–20 minutes outdoors every week completing his or her journal. Averaging the

Table 1. Survey results: students' nature exposure.

On average, how much time each week did you spend outdoors to complete your nature journal? (n = 50)

| | | | | |
|--------------------|----------------------|----------------------|---------------------|-------------------|
| <10 minutes 20% | 11–20 minutes 42% | 21–30 minutes 30% | 31–40 minutes 4% | >41 minutes 4% |
|--------------------|----------------------|----------------------|---------------------|-------------------|

On average, how much time each week do you normally spend engaging in outdoor activities (other than walking to class or incidental nature exposure)? (n = 39)*

Mean = 5.68 hours, standard deviation = 6.32 hours

*An outlier of 35 hours per week was removed. The *n* otherwise would have been 40. The excluded value was more than 10 hours higher than the value reported by any other student. If this outlier is included, the mean becomes 6.41 and the standard deviation becomes 7.77.

upper and lower bounds of the median category indicates that the median student spent an additional 15.5 minutes outdoors on average, a 4.6% increase in the average student's weekly self-reported nature exposure of 5.66 hours.

There was a statistically significant, positive association between the amount of time a student spent outdoors journaling and the amount of time the student reported spending in nature generally (Spearman's $\rho = 0.3171$, $p < 0.0461$). This analysis cannot determine whether a predisposition towards spending time outdoors caused students to spend more time journaling or vice-versa.

Students changed perceptions about and became more aware of nature

Seventy-four percent of respondents said that journaling increased their awareness of nature somewhat or a great deal. For some, journaling increased their awareness in specific ways. One student reported that 'journaling helped me be more in tune with seasonal changes'. Another noted that 'when going to my nature place each week I became more aware of how it contributes to the neighborhood'. Others expressed a general increase in awareness, observing that 'there are things you don't notice when you are just passing through. But when you spend time there just sitting and watching and enjoying the nature, you notice a lot more and that made me appreciate it more'. Some students specifically indicated that 'research [I] conducted in order to do the journal had some new information to me' and 'writing the journals made me look for a various information'.

When students did not report increased awareness, they tended to say that 'I was already aware of the natural environment' or 'I don't pay attention any more to the environment than I did before'. There was no statistically significant correlation between students' post-journaling levels of nature awareness and the amount of time they reported regularly spending outdoors.

Sixty-eight percent of respondents said that the project changed the way they thought about nature somewhat or significantly. This question was intentionally ambiguous because journaling could have changed students' thinking in many ways. Some students mentioned specific cognitive changes, noting that '[I] realized how much I impact nature' and 'I realized what could happen to my nature place if taken away. I saw that many people enjoyed my nature place'. Other students indicated that their thinking was generally and positively affected, commenting that 'I never really

Table 2. Survey results: students' perceptions about journaling.

| | |
|--|--|
| <i>Did completing the nature journal entries make you want to spend additional time outdoors? (n = 50)</i> | |
| Yes, significantly 8% | Yes, somewhat 48% |
| | No change in my desire to be outdoors 38% |
| | No, I was somewhat less interested in being outdoors 6% |
| <i>Did completing the nature journal entries change the way you think about nature? (n = 50)</i> | |
| Yes, significantly 12% | Yes, somewhat 56% |
| | No change in the way I think about nature 32% |
| <i>How much did completing the nature journals increase your awareness of the natural environment? (n=50)</i> | |
| A great deal 18% | Somewhat 56% |
| | No change in my awareness 26% |
| <i>How much did completing the nature journal entries enhance your understanding of the course materials? (n = 49)</i> | |
| A great deal 2% | Somewhat 53% |
| | Not at all 45% |

sat outside and just observed, it's relaxing and interesting and if I had more free time I would like to do it more often' and 'I'm really attached to my nature journal spot. I know that sounds weird, but I love it and would hate to see something happen to it'.

The reasoning of students who said that their thinking was unaffected is typified by the comment that 'in my life I have been outdoors a lot and the way I think about nature did not change... I appreciated nature before and now, the nature journals did not influence me at all'. There was no statistically significant correlation between students' post-journaling levels of thinking about nature and the amount of time they reported regularly spending outdoors.

Students did not necessarily connect journaling with class activities

Fifty-five percent of survey respondents reported that journaling enhanced their understanding of course materials. Forty-five percent said they did not see such a connection.

That a number of students failed to grasp this linkage is not without precedent. In a content analysis of 880 journal entries written by college-level outdoor recreation students, O'Connell and Dymont (2004, 166) found that 'less than one percent of journal entries made connections between academic theory and field courses'. In fact, instructors who assign journaling often report that the activity does not sufficiently foster connections between classroom concepts and real-life issues or theory (Anderson 1992; Chandler 1997; Dymont and O'Connell 2003; Spaulding and Wilson 2002).

The disconnect some students perceived may be partly due to the imperfect fit between the structure of the project and the course in which it was used. The topical survey course covered a wide range of environmental issues. It was not always feasible to connect the week's topics directly to issues affecting students' local nature sites. Although some themes ran through classroom activities and journal prompts, such as sustainability, the connection often was subtle.

Journaling may not have started a lasting trend in nature exposure

The project's final goal was to encourage students to spend time in nature after the project ended. Fifty-six percent of respondents said that journaling somewhat or significantly increased their interest in spending time outdoors. Thirty-eight percent said that their interest was unaffected, and 6% said that they were less interested in spending time in nature as a result of the project.

An ideal evaluation of long-term behavioral changes would have used a pre- and post-test design wherein students were queried about the amount of time they spent outside before the project began and then at regular intervals afterwards. Lacking such a design, I turn to cognitive and learning theory, as well as recent theorizing concerning the nature of digital screen-mediated relationships. This scholarship suggests limits to the project's long-term impact on nature exposure.

Students who spent more time outdoors journaling were more likely to say that journaling increased their interest in spending time outdoors (Spearman's $\rho = 0.2410$, $p < 0.0918$). However, there was no statistically significant association between the amount of time students spent outdoors journaling and any apparent changes in their thinking about or awareness of nature. Changes in awareness or thinking are deep cognitive shifts whose movement may require a more fundamental lever than the activities this project demanded. Students might have enjoyed

sitting outside and working on their journals and so reported an increased interest in being in nature. But if this interest is unconnected to meaningful cognitive shifts, long-term behavioral change is less likely (Hupp, Reitman, and Jewell 2008).

Students may not have experienced such cognitive shifts because the project involved relatively passive tasks. Students observed and wrote about nature. They did not pick up litter or plant trees. This lack of tangible engagement mirrors the lack of tangible engagement associated with technologies Net Generation students use. Connecting with peers via a social networking site is not the same as sitting down to coffee. Some research suggests that screen-mediated relationships are more superficial than those based on in-person interactions (Buffardi and Campbell 2008; Dwyer 2007). Use of Facebook, for example, is typically associated with the formation of ‘bridging’ social capital (Steinfeld, Ellison, and Lampe 2008), or ‘weak ties’, relationships that facilitate information sharing but not deep emotional connection (Granovetter 1973). Using screen-based technologies to learn about nature arguably fosters shallow, screen-based-type engagement with nature.

This argument finds support in experiential learning theory, wherein ‘learning is the process whereby knowledge is created through the transformation of experience’ (Kolb 1984, 38). This transformation proceeds in phases: (1) concrete experience, (2) observation and reflection, (3) development of abstract concepts via critical thinking, and (4) testing concepts in new situations (Kolb 1984, 38). The nature journal project only accessed the second and third elements of Kolb’s cycle—the most passive ones. Students may not have had fully transformative experiences, and the project’s long-term impact may be accordingly muted.

Implications for future practice and research

Future practice

Students’ generally positive assessment of online multimedia nature journaling, as well as the literature which argues that this type of educational initiative appeals to Net Generation learners, affirms the project’s value. However, the project still could be improved.

(1a) Couple passive activities with active ones. Document both online.

Students could journal about nature sites where the instructor has established arrangements allowing students to pursue environmentally beneficial activities. Such sites could include community gardens or local parks. Journal prompts could ask students to observe their sites one week and weed invasive species the next. Students could pursue these activities in groups (see suggestion 3a).

Students could post online videos recording their achievement of outdoor tasks or interviews with site owners. They could use media technologies to create a montage of the semester’s visual evidence and present the montages to the class. This project restructuring would strengthen students’ connection to the local environment by more deeply interweaving their online and offline worlds.

(2a) Bolster the connection between classroom activities and nature journaling.

Students who grasped this connection seem to have benefited from other dimensions of the journaling project too. Students who thought that journaling enhanced their understanding of course materials were more likely to spend extra time outdoors

Table 3. Survey results: thematic analysis of open-ended responses.

| | |
|---|-----|
| The paraphrased question is presented, followed by the themes that dominated the open-ended responses. The themes are not actual student quotes but rather composite sentences. The <i>n</i> values are the number of respondents that provided open-ended responses. | |
| <i>How nature journaling affected the student's thinking about nature: (n = 29)</i> | |
| The student cited a specific realization he/she had about nature | 41% |
| The student said his/her thinking was unaffected because he/she already spent time outdoors | 28% |
| The student reported that nature journaling was a new and/or positive experience | 17% |
| Other | 14% |
| <i>How nature journaling affected the student's awareness of nature: (n = 33)</i> | |
| The student cited a specific change in awareness of nature | 37% |
| The student expressed general awareness or appreciation | 24% |
| The student said that research required to complete the nature journals increased his/her awareness of nature | 12% |
| The student reported that he/she was already aware of nature | 12% |
| <i>Why the student disliked the nature activity: (n = 28)</i> | |
| The student did not dislike the project and instead expressed enthusiasm about it | 28% |
| Nature journal topics and class topics did not seem to correspond | 26% |
| Completing the journal took too much time or was a hassle | 23% |
| Other | 14% |
| The student expressed general dislike for the project | 6% |

completing the journals (Spearman's $\rho = 0.3079$, $p < 0.0314$) and were more likely to report enhanced nature awareness (Spearman's $\rho = 0.5649$, $p < 0.0075$) and greater interest in spending time outdoors (Spearman's $\rho = 0.2383$, $p < 0.0992$). This analysis could not evaluate whether students' perceptions of journaling's course-related utility caused these outcomes or vice-versa. However, it seems reasonable that students would learn more from both journaling and classroom activities if they could perceive their interrelationship. Strengthening this connection also would eliminate one of students' main objections to the project (see bottom of Table 3).

The main obstacle to creating a stronger connection was the topics-focused nature of the course in which the journals were used. Assuming that the course could not be fundamentally restructured, there seem to be two solutions. First, the project could be restructured such that in weeks when the course's content would be amenable to a local connection, students could complete observation-focused journal entries. In a week devoted to food policy, for example, the journal prompt could ask students to draft a plan for using their sites to produce food for the community. But in weeks when the topics did not lend themselves to a local connection, students could pursue a hands-on site activity.

Second, class time could be set aside weekly for students to share recent nature journal experiences in groups. Bringing journaling reflection into the classroom would encourage students to perceive journaling as a key course element. The instructor could guide discussion so that students could see the more subtle connections between course content and journal activities. Students would reap the benefits of collaborative learning.

(3a) Consider a privacy-sensitive journal-sharing format.

Allowing students to read one another's content might limit the problem of students writing what they believe the teacher expects rather than developing their own thoughts (Anderson 1992), and encourage students to build a learning community rather than wait for centrally disseminated knowledge (Chandler 1997; Lave 2009). However, Anderson (1992) cautions that when students share journal entries, the instructor must carefully ensure that students do not denigrate one another's personal experiences.

A middle ground could involve sharing in small groups. Group members could comment on one another's entries and perhaps work together on field activities. Interpersonal trust would likely develop more easily in a small group than across an entire class, perhaps making students more comfortable with peer sharing. Group rather than whole-class sharing would give the instructor a smaller volume of online interpersonal communication flows to monitor. At the outset, the instructor could emphasize that students could still keep elements of their journals private. The instructor should regularly evaluate whether the remaining risks to privacy appear outweighed by benefits.

(4a) Consider the context-specific benefits and costs of moving to a different assessment approach.

When students receive grades for journaling, they may write what they believe the instructor expects rather than their own ideas (Anderson 1992; Hobbs 2007). Chandler (1997, 46) calls journaling for a grade 'dehumanizing', arguing that even when instructors provide feedback along with grades (as occurred in this project), the student feels frustrated by a one-sided critique masquerading as dialog. How-

ever, Karcher (1988) notes that although a student who knows his or her work will be graded will keep in mind the reader's expectations, this orientation can sometimes encourage journal entries more comprehensive or creative than those written without assessment expectations.

Decisions about grading must be made with as much information as possible about the students. Highly interested, motivated students may be more likely to perceive structured grading as inhibiting their personal learning. Other students may eventually find journaling rewarding, but may need the clear expectation of a grade to induce them, at least initially, to complete journal entries.

Future research

These data came from a simple survey. A more elaborate research design could explore the impact of online multimedia nature journals more thoroughly.

(1b) Use a pre- and post-test design.

When students only complete a post-participation survey, they may have trouble accurately recalling pre-project perceptions. Their recollections may be influenced by their project experiences. A pre- and post-test design reduces these potential biases.

This design also would help better approximate causal relationships. For example, it is appealing to interpret the data as suggesting that the more time a student spends journaling outdoors, the greater is the likelihood that he or she will want to spend more time outside. However, perhaps the causal arrows run the other way. A more robust strategy would be to ask students at the outset to rate their interest in spending more time outdoors, ask the same question at the end, and then evaluate any rating changes.

A pre-test could establish useful baselines. One of the project's assumptions was that because students often take the course in which journaling was assigned for non-substantive reasons, many participants would lack extensive environmental awareness and might have significant misconceptions about nature. A pre-test probing this assumption could have helped to tailor the project more accurately to student needs. Also, because students' nature-related perceptions had not been assessed initially, the post-project survey could only identify the substance and direction of changes in those perceptions if students described the changes in open-ended responses. A pre-test would have permitted a more informative post-test.

(2b) Comparatively analyze project impact.

This research did not investigate how well the online multimedia journaling format enhanced learning relative to other journaling formats. It assessed the project's overall benefits but did not parse out the specific contribution of each online multimedia component.

Ideally, multiple sections of the same course could participate in a nature journaling experiment. Students in one section could keep an online multimedia journal and students in another could keep an ink-and-paper journal. Relevant outcomes could be compared. This experiment could be iterated, subtracting or adding novel components like video posting capability, to tease out their 'value added'. Similarly valuable would be comparisons across sections where journals would and would not be private. Finally, a control section with no journaling would allow the educa-

tor to evaluate whether any of the variations in journaling format or structure significantly appear to affect learning or nature appreciation relative to a no-journal baseline.

(3b) Measure behavior as well as perceptions.

This research investigated students' own assessment of their comprehension of course materials and their environmental awareness, nature-related perceptions, and interest in spending more time outside. It did not directly assess these outcomes using behavioral observation or tests. Understanding student perceptions is important in its own right. However, more intensive inquiry could reveal more about the tangible impacts of online multimedia nature journaling.

(4b) Complement quantitative analysis with qualitative.

Nature journal content could provide insight into the type and depth of students' cognitive shifts. Textual analysis would allow the researcher to trace changes in students' nature-related perceptions over the life of the project and understand which activities affected students the most. This analysis also could be an avenue for investigating the post-modern critique that reflective writing may not be a useful curriculum component because (among other reasons) it can reinforce students' pre-existing conceptions and biases rather than foster new perspectives (Fendler 2003).

Conclusion

Weekly journaling about nature using an online multimedia platform appears to be a useful tool for slightly increasing the amount of time university students spend outdoors, enhancing their environmental awareness, and changing their nature-related perceptions. However, there are theoretical reasons to question the depth and duration of such impacts when they are achieved via an environmental education strategy that relies heavily on technological interfaces. Online journaling can be a valuable first step in encouraging the nature-estranged Net Generation to appreciate the environment. However, deeper engagement with nature may still require students to step away from the screen.

Notes

1. I later discuss the debate over grading academic journals.
2. Options for increasing time spent at the nature site are discussed later.
3. All student work used with permission and institutional review board approval.
4. One question asked students to calculate the total amount of time they spent journaling weekly, adding time spent indoors and outdoors. Those data are not relevant to this analysis.

Notes on contributor

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