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# The Psychological Benefits of Virtual Forest Bathing: A Classroom-Based Study Using Simulated Nature Exposure

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**Abstract**

Forest bathing, or *shinrin-yoku*, is a practice origin in Japanese culture that involves immersive exposure to natural environments to promote health and well-being. This study investigates the efficacy of a virtual forest bathing experience in a university classroom setting, where logistical constraints prevent direct access to natural environments. Using a 5-minute video simulating a forest walk, this study measured psychological changes in 27 students via the Positive and Negative Affect Schedule (PANAS) before and after exposure. Wilcoxon signed-rank test revealed significant reductions in negative affect (e.g., guilt, fear, nervousness) with p-values <0.05, while positive affect remained largely unchanged. Participant feedback confirmed subjective improvements in mood and enhanced student engagement through experiential learning, suggesting that brief virtual nature exposure can produce measurable psychological and educational benefits. These findings highlight the potential of virtual interventions as accessible tools for promoting mental health and advancing landscape architecture education.

**Keywords:** virtual forest bathing, experiential learning, psychological health, landscape architecture education

## 1. Introduction

Forest bathing, known as *shinrin-yoku* in Japan, is a therapeutic practice involving sensory engagement with natural environments to enhance physical and psychological well-being (Park et al., 2010). Forest bathing involves mindful immersion in natural settings, engaging senses such as sight, sound, and smell. Originating in the 1980s, it has gained attention due to empirical evidence linking nature exposure to reduced stress, improved mood, and physiological benefits such as lower blood pressure and cortisol levels (Ideno et al., 2017; Li, 2010; Morita et al., 2007). Lee et al. (2009) investigated the effects of viewing green spaces on physiological indicators such as blood pressure, pulse rate, and salivary cortisol levels. Similarly, Grazuleviciene et al. (2016) examined changes in heart rate and cortisol levels among patients with coronary artery disease following walks in both forest and urban environments. The health benefit of forest bathing was also reflected on psychological sides. Forest bathing involves mindful immersion in natural settings, engaging senses such as sight, sound, and smell. Studies have demonstrated its benefits, including reduced stress (Emi Morita et al., 2007) improved mood (Miyazaki et al., 2011). These effects are attributed to phytoncides (volatile organic compounds emitted by trees) and the calming influence of natural stimuli.

These studies typically employ natural experiments, where participants engage in forest-based interventions—such as walking or sitting quietly—followed by pre- and post-intervention measurements (physiological or psychological), often compared with control groups to assess effectiveness. However, such interventions are not always feasible in all research or educational settings, thereby prompting the development of alternative approaches that employ virtual materials as a form of simulated nature exposure.

Back to the 80s, Ulrich (1984) has demonstrated that even passive exposure to nature—such as having a hospital room window with a view of greenery—could significantly improve patient recovery outcomes. A recent qualitative study by McEwan et al. (2023) further supports this trend, showing that virtual forest bathing programs can effectively promote wellbeing, nature connectedness, and emotional restoration among adults with mobility impairments through accessible digital formats. Complementing this perspective, Masters et al. (2024) explored the role of visual realism in virtual reality forest bathing and found that high-realism environments may enhance perceived restorativeness, suggesting that the design quality of virtual nature significantly influences its psychological benefits.

In educational settings, fostering student engagement and understanding of complex concepts like the health benefits of nature requires pedagogical approaches that prioritize intuitive and experiential learning. According to

Kolb's Experiential Learning Theory (EXPERIENTIAL, 2014), effective learning occurs through a cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. Similarly, active learning approaches emphasize student participation in hands-on activities, which can improve both comprehension and motivation (Freeman et al., 2014). These theories support the use of classroom-based experiments that provide tangible, observable outcomes, as they enhance students' reception by making abstract concepts concrete and relatable (Carr et al., 2015). In the context of landscape architecture education, Gazvoda (2002) emphasizes the importance of integrating both creative and scientific approaches, arguing that students benefit most when they are taught to navigate between detailed design and broader ecological systems through direct and layered experience.

In landscape architecture education, teaching the health effects of green spaces presents both opportunities and challenges. Experiential learning is ideal; however, logistical constraints often make direct forest exposure infeasible. To address this limitation, this study investigates whether a simulated forest bathing experience—via a short, immersive video—can replicate the emotional benefits associated with real forest exposure. By actively engaging students in this experiment and guiding them through pre- and post-assessment using psychological measures, the intervention not only offers an accessible alternative to in-person forest experiences but also enhances students' understanding of forest bathing theory and the empirical foundations behind it.

## 2. Methodology

### *2.1 Participants*

The study involved both undergraduate and graduate students (aged 20–26) enrolled in a landscape education course at a university. Participation was voluntary, and informed consent was obtained via oral confirmation. No demographic data were collected to maintain anonymity.

### *2.2 Materials*

A 5-minute video simulating a forest walk was selected for its high-quality visuals and natural soundscape (e.g., birdsong, rustling leaves). The Positive and Negative Affect Schedule (PANAS) was used to measure emotional states. The PANAS scale is a validated tool for measuring positive and negative affect, consisting of 20 items rated on a 5-point Likert scale (Crawford and Henry, 2004). It is widely used in psychological research to assess emotional states, making it suitable for evaluating the immediate effects of virtual forest bathing. The scale includes 10 positive (e.g., "enthusiastic," "inspired") and 10 negative (e.g., "guilty," "nervous") affect items, rated from 1 (very slightly or not at all) to 5 (extremely).

### *2.3 Procedure*

The experiment was conducted during a class session on the health effects of green spaces, following a lecture on forest bathing's definition and origins. Then the students were asked to complete the PANAS questionnaire (pre-test) to establish baseline affect (voluntary attend and oral content obtained). They then watched the 5-minute forest bathing video in a quiet classroom setting. During the viewing, participants were instructed to engage with the video immersively—imagining themselves physically present in the forest setting depicted. Mobile phones were set to silent mode, and students who chose not to participate were asked not to disturb those taking part, to maintain a focused and immersive environment. Immediately after, they completed the PANAS again (post-test). Participants were encouraged to reflect on changes in their emotional state, and oral feedback was collected to gauge subjective experiences.

### *2.4 Data Analysis*

Eventually 27 paired tests were collected (unpaired samples were excluded from the analysis) Due to the small sample size (n=27) and the non-normal distribution of the data, the Wilcoxon signed-rank test, was used to compare pre- and post-test scores for each PANAS item. Significance levels were set at $p < 0.05$ (*), $p < 0.01$ (**), and $p < 0.001$ (***). Mean changes and p-values were calculated to assess the intervention's impact on positive and negative affect. Effect sizes were estimated using the Wilcoxon test's z-statistic converted to a rank-biserial correlation coefficient (r) to quantify the magnitude of changes.

## 3. Results

The results, summarized in Table 1, demonstrate that the 5-minute virtual forest bathing intervention significantly reduced negative affect across multiple PANAS items, while positive affect showed minimal changes. The analysis employed Wilcoxon signed-rank tests for each of the 20 PANAS items, with effect sizes calculated to quantify the magnitude of changes.

Table 1. PANAS Pre- and Post-Test Results for Virtual Forest Bathing

| Emotion Dimension | Pre-Mean | Post-Mean | Mean Change | z | p-value |
|---|---|---|---|---|---|
| **Negative Affect (NA)** | 7.3 | 2.6 | -4.7 | -4.52 | <0.001* |
| **Guilty** | 1.07 | 0.11 | -0.96 | -4.12 | <0.001*** |
| **Afraid** | 1 | 0.11 | -0.89 | -4.01 | <0.001*** |
| **Nervous** | 1.3 | 0.41 | -0.89 | -3.24 | 0.001** |
| **Upset** | 1 | 0.3 | -0.7 | -3.1 | 0.002** |
| **Hostile** | 0.93 | 0.22 | -0.71 | -3.01 | 0.003** |
| **Jittery** | 0.93 | 0.3 | -0.63 | -2.89 | 0.004** |
| **Ashamed** | 0.89 | 0.33 | -0.56 | -2.65 | 0.008** |
| **Distressed** | 0.93 | 0.44 | -0.49 | -2.45 | 0.014* |
| **Irritable** | 0.89 | 0.41 | -0.48 | -2.41 | 0.016* |
| **Scared** | 0.85 | 0.41 | -0.44 | -2.35 | 0.019* |
| **Positive Affect (PA)** | 10.7 | 10 | -0.7 | -0.33 | 0.742 |
| **Strong** | 1.41 | 1.07 | -0.34 | -1.72 | 0.085 |
| **Alert** | 1.44 | 1.19 | -0.25 | -1.43 | 0.153 |
| **Enthusiastic** | 1.37 | 1.22 | -0.15 | -0.98 | 0.328 |
| **Attentive** | 1.48 | 1.37 | -0.11 | -0.8 | 0.422 |
| **Inspired** | 1.33 | 1.26 | -0.07 | -0.4 | 0.689 |
| **Excited** | 1.3 | 1.26 | -0.04 | -0.28 | 0.782 |
| **Determined** | 1.48 | 1.48 | 0 | -0.05 | 0.957 |
| **Active** | 1.44 | 1.52 | 0.08 | 0.8 | 0.422 |
| **Proud** | 1.22 | 1.33 | 0.11 | 0.98 | 0.328 |
| **Interested** | 1.59 | 1.74 | **0.15** | 1.43 | 0.153 |

***p < 0.001, **p < 0.01, *p < 0.05

*3.1 Negative Effect*

The virtual forest bathing intervention led to statistically significant reductions in all 10 negative affect items, with p-values ranging from 0.019 to <0.001, as determined by Wilcoxon signed-rank tests. The largest effect was observed for the composite negative affect score, which decreased from a pre-test mean of 7.30 to a post-test mean of 2.60 (mean change = -4.70, z = -4.52, p < 0.001, r = 0.84). Individual items showed substantial reductions, particularly for "guilty" (mean change = -0.96, z = -4.12, p < 0.001, r = 0.76) and "afraid" (mean change = -0.89, z = -4.01, p < 0.001, r = 0.74), both exhibiting highly significant changes with large effect sizes. Other items, such as "nervous" (mean change = -0.89, z = -3.24, p = 0.001, r = 0.60), "upset" (mean change = -0.70, z = -3.10, p = 0.002, r = 0.57), and "hostile" (mean change = -0.71, z = -3.01, p = 0.003, r = 0.56), also showed robust reductions with moderate to large effect sizes. The smallest significant change was observed for "scared" (mean change = -0.44, z = -2.35, p = 0.019, r = 0.44).

*3.2 Positive Affect*

In contrast, the intervention had minimal impact on positive affect. The composite positive affect score decreased slightly from 10.70 to 10.00 (mean change = -0.70, z = -0.33, p = 0.742, r = 0.06), which was not statistically significant. Among individual positive affect items, none reached statistical significance (p-values ranging from 0.085 to 0.957). The largest change was observed for "strong" (mean change = -0.34, z = -1.72, p = 0.085, r = 0.32), followed by "alert" (mean change = -0.25, z = -1.43, p = 0.153, r = 0.27) and "interested" (mean change = 0.15, z = 1.43, p = 0.153, r = 0.27). Slight increases were noted for "active" (mean change = 0.08, z = 0.80, p = 0.422, r = 0.15) and "proud" (mean change = 0.11, z = 0.98, p = 0.328, r = 0.18), but these changes were not statistically significant.

### *3.3 Qualitative Feedback*

Oral feedback from participants corroborated the quantitative findings. Many students reported feeling "calmer," "less anxious," or "more relaxed" after watching the video. Several noted a noticeable shift in their emotional state when completing the post-test PANAS, describing the experience as "soothing" or "refreshing." These subjective reports were consistent with the significant reductions in negative affect. Additionally, the participants reported that they have noticed their emotional change vastly when they were doing the post-test PANAS.

## 4. Discussion

The results demonstrate that a brief 5-minute virtual forest bathing intervention, delivered via a high-quality video, significantly reduced negative affect among 27 undergraduate and graduate students in a landscape architecture classroom, as evidenced by Wilcoxon signed-rank tests ($z = -4.52$ to $-2.35$, $p < 0.001$ to $p = 0.019$). The robust decreases in negative emotions such as guilt ($z = -4.12$, $p < 0.001$), fear ($z = -4.01$, $p < 0.001$), and nervousness ($z = -3.24$, $p = 0.001$), which was consistent with prior research on both in-person and virtual nature exposure (Browning et al., 2020; Morita et al., 2007; Ulrich et al., 1991). The large effect sizes ($r = 0.44$ to $0.84$) for negative affect items underscore the intervention's efficacy in alleviating negative emotional states, supporting its potential as a practical tool for educational settings where direct access to natural environments is limited.

### *4.1 Effectiveness of Virtual Forest Bathing*

The significant reductions in negative affect are consistent with studies on in-person forest bathing, which have reported decreased stress, anxiety, and negative mood states (Ideno et al., 2017; Morita et al., 2007; Park et al., 2010). For instance, Morita et al. (2007) found that forest walks reduced self-reported stress and negative emotions, this study's also showed significant reductions in negative items such as "nervous" ($z = -3.24$, $p = 0.001$) and "distressed" ($z = -2.45$, $p = 0.014$) scores. The virtual nature of this intervention reflects recent findings by McEwan et al. (2023), who demonstrated that virtual forest bathing programs promoted emotional restoration and well-being among adults with mobility impairments. Similarly, Masters et al. (2024) found that high-realism virtual environments enhanced perceived restorativeness, suggesting that the high-quality visuals and soundscape in our selected video likely contributed to the observed effects. Although Masters et al. (2024) argued that virtual environments have health benefits, they also noted that these effects tend to be somewhat smaller compared to in-person exposure to natural settings. Nevertheless, for individuals who face practical barriers to accessing physical natural environments, virtual forest bathing still demonstrates effectiveness, particularly in alleviating negative emotions.

The lack of significant changes in positive affect contrasts with some studies that report increases in positive emotions following nature exposure (McMahan and Estes, 2015; Miyazaki et al., 2011). This discrepancy may be attributed to the brevity of the intervention (5 minutes), as longer exposures (e.g., 20–30 minutes) are often required to enhance positive affect (Barton and Pretty, 2010). The immersive instructions provided to participants—encouraging them to imagine themselves in the forest setting—may have enhanced the reduction of negative affect but were insufficient to boost positive emotions, as reflected by the small effect sizes. Another possible explanation for the nonsignificant positive effects observed could be that students' baseline affect was already relatively positive in the classroom setting, leaving limited room for further improvement through the intervention.

### *4.2 Implications for Education and Landscape Design*

The findings of this study offer significant implications for both educational practices in landscape architecture and the broader field of urban design. In educational settings, the integration of virtual forest bathing interventions into landscape architecture and environmental education curricula can enhance experiential learning, as advocated by Kolb's Experiential Learning Theory (EXPERIENTIAL, 2014). By engaging students in brief, immersive activities like the one tested, educators can provide tangible demonstrations of the psychological benefits of green spaces, fostering a deeper understanding of how nature impacts well-being. The immersive instructions used in this study—prompting students to imagine themselves physically present in the forest—followed active learning principles (Freeman et al., 2014) and Gazvoda's (2002) call for layered, experiential approaches in landscape architecture education. These instructions likely amplified the intervention's impact, as evidenced by participants' reflects like they can find themselves improving emotional status when completing the post-test PANAS. These instructions likely enhanced the intervention's effectiveness, as reflected in participants' reports of noticeable improvements in their emotional states when completing the post-test PANAS. This hands-on, experiential approach allows students to directly experience the concepts being taught, thereby deepening their understanding of both the theory and the experimental methods used to validate it. Compared to simply presenting research findings on forest bathing, actively involving students in the experimental process more effectively facilitates

comprehension and engagement. Such activities can bridge the gap between theoretical knowledge and practical application, enabling students to connect abstract concepts like shinrin-yoku with measurable emotional outcomes.

This approach is particularly valuable in urban universities or regions with limited access to natural environments, where logistical constraints often preclude direct forest exposure. The use of widely accessible platforms like YouTube makes virtual interventions cost-effective and scalable, allowing educators to incorporate them into diverse classroom settings. By embedding such experiments within curricula, educators can not only teach the science behind nature's health benefits but also cultivate students' appreciation for ecological systems, a core tenet of landscape architecture education (Gazvoda, 2002). Furthermore, the significant reductions in negative affect suggest that virtual forest bathing could be used as a stress management tool for students, supporting mental health in high-pressure academic environments.

### *4.3 Limitations and Future Directions*

Several limitations should be noted. First, the small sample size (n=27) and non-normal data distribution necessitated the use of the Wilcoxon signed-rank test, which, while appropriate, limits the generalizability of the findings compared to parametric tests with larger samples. The robust z-statistics (e.g., $z = -4.52$ for negative affect) provide confidence in the results, but future studies should involve larger, more diverse samples, including both undergraduate and graduate students, to enhance generalizability. Second, the absence of a control group (e.g., participants watching a neutral video) prevents causal attribution of the effects to the forest video specifically. Future research could include a control condition to isolate the impact of nature imagery. Third, the 5-minute duration may have been insufficient to elicit changes in positive affect, as evidenced by the small z-statistics (e.g., $z = -0.33$ for positive affect). Longer interventions (e.g., 10–15 minutes) or repeated exposures could be tested to explore potential effects on positive emotions. Future studies could explore virtual reality interventions to enhance immersion.

The exclusion of unpaired samples ensured data integrity but reduced the sample size, potentially limiting statistical power. Qualitative feedback, collected informally via oral reports, provided valuable insights but could be enriched through structured interviews or open-ended questionnaires to capture participants' experiences more comprehensively. Additionally, exploring moderators such as video quality, participant engagement, or prior exposure to nature could clarify factors influencing the intervention's effectiveness.

## 5. Conclusion

This study examined the emotional effects of a simulated forest bathing experience through a virtual video intervention in a university classroom setting, finding significant reductions in negative emotions and demonstrating that such immersive, experiential approaches can enhance students' understanding of theoretical concepts in landscape health education. The success of this brief, immersive intervention suggests that virtual forest bathing can be integrated into various settings beyond education, such as mental health programs or workplace wellness initiatives. Its low cost and accessibility, using widely available platforms like YouTube, make it a scalable solution for promoting well-being in urban environments. Educators can use similar activities to teach students about the science of nature's health benefits while fostering engagement through experiential learning. The immersive instructions used in this study could be standardized in future interventions to enhance effectiveness across diverse populations.

## 6. Conclusion

This study provides evidence that a 5-minute virtual forest bathing experience significantly reduces negative affect in a classroom setting, offering an accessible alternative when direct nature exposure is impractical. The intervention's effectiveness, supported by both quantitative PANAS data and qualitative feedback, highlights its potential as a tool for experiential learning and mental health promotion. Future research should address limitations such as sample size and lack of a control group while exploring longer or more immersive interventions. These findings advocate for the integration of virtual nature experiences in educational and urban design contexts to enhance psychological well-being.

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