Contribution of Research

The Effects of Short-Term Natural Environment Exposure on Preservice Teacher Well-Being

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Abstract

This study explores changes in well-being for 16 preservice teachers in natural and simulated professional development environments. The Rumination Questionnaire and Profile of Mood States (POMS) were used as indicators of well-being. A follow-up survey assessed changes in preservice teachers' well-being strategies four months later. Compared to the professional development setting, the natural environment positively affected rumination and POMS scales of Tension-Anxiety, Confusion-Bewilderment, Esteem-Related Affect, and Total Mood Disturbance. Follow-up data found that participants agreed that spending time in natural settings improved their well-being; however, time constraints limited doing so. Conclusions suggest that preparation programs consider including nature-based experiences as one strategy for developing teacher well-being.

Keywords: Preservice Teachers, Well-Being, Resilience, Environment, Professional Development

Well-being is defined as a positive state of psychological, emotional, and physical health contributing to productive functioning and flourishing (e.g., Aelterman et al., 2007; Benevene et al., 2020; Collie et al., 2015). As a group, teachers face significant challenges to their well-being. These include high levels of stress and the ripple effects of teacher burnout and attrition (Greenberg et al., 2016; Marken & Agrawal, 2022; Schonfeld & Bianchi, 2016). Teacher well-being also directly and indirectly affects student well-being, including grades, standardized test scores, school satisfaction, behavior, and social-emotional functioning (e.g., Arens & Morin, 2016; Darling-Hammond, 2003; Greenberg et al., 2016; Herman et al., 2018; Jennings et al., 2019; Oberle & Schonert-Reichl, 2016; Ronfeldt et al., 2013). In the following paragraphs, we review the literature regarding teacher stress, particularly beginning teachers' stress, and suggest reframing these challenges in light of a resilience framework. We review the literature on how natural environments support well-being and may promote resilience. We conclude this introduction with a description of the purpose of this study, which is to explore the effects of time spent in nature on preservice teachers' well-being.

Teacher Stress

Prior to 2020, surveys found that teaching was one of the most stressful professions in the United States (American Federation of Teachers, 2017; Gallup, 2014). The COVID-19 pandemic heightened concerns, as educators faced increased stressors impacting their personal and professional lives (Baker et al., 2021; Brackett & Cipriano, 2020; Sokal et al., 2020). The 2021 State of the U.S. Teacher Survey (Steiner & Woo, 2021) found that 78% of teachers reported frequent job-related stress compared to 40% of the general U.S. population. These

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levels are similar to those reported for teachers who left the profession pre-pandemic. Fifty percent of teachers reported feeling burned out, and 25% reported symptoms of depression. The report warns of immediate and future teacher shortages and calls for designing and implementing supports for reducing teacher stress and buoying mental health. Other reports detail similar findings, identifying trauma and stress, including pupil stress, as one of five contributors to dwindling teacher supply and high attrition rates (Darling-Hammond, 2022; Darling-Hammond et al., 2020).

Beginning Teacher Stress

Beginning teachers may be especially vulnerable to the effects of stress, during preservice and the induction years. Despite the assumption that novice teachers' idealism provides a buffer, Fitchett et al. (2018) found that 25% of teachers were at risk of occupational stress during their first year, similar to their more experienced colleagues (Lambert et al., 2015). In a large 10-year cohort study (2010-2020), Horn et al., (2021) found that first-year teachers were least likely to be retained (87.5%), followed by year two (79.7%) and three (73.6%). At year five, the retention rate for classroom teachers was 69.3% and 73% for those who had left the classroom but remained in the field of education.

It is of particular note that many beginning teachers transition to the classroom at a time of heightened susceptibility to mental health issues. Emerging adulthood (ages 18-25) is a peak window for the onset of disorders such as anxiety, mood, psychosis, and substance abuse (de Girolamo et al., 2012; Stone et al., 2012). Twenge et al., (2019) found significant increases in major depression (63%), serious psychological distress (71%), and suicidality (47%) for adults ages 18-25, but no significant increase in ages 26 and older. Concerns about college students' mental health have surged in the last decade, including substantial increases in anxiety, depression, and stress (Center for Collegiate Mental Health, 2018; Scheffler, 2018). Moreover, for teachers to be knowledgeable and responsive to student mental health needs, including social-emotional learning and mental, emotional, or substance abuse disorders (e.g., Texas Education Code 21.044c-1), they must first possess the ability to care for their own mental health. Being mentally healthy is more than the absence of illness and is a key aspect of well-being. Preservice education, therefore, is a fitting time to help beginning teachers learn to manage the stressors of life and the profession to promote their own well-being.

Teacher Resilience

Instead of viewing these concerns from a deficit model, we embrace Day and Gu's (2014) concept of "everyday resilience." This is defined as "the capacity and capability to be sufficiently resilient to have the desire, determination and energy, as well as the knowledge and strong moral purpose which enable teachers to teach to their best" (p. 20). This entails more than the ability to manage challenges and survive or adapt despite adversity (Bottrell, 2009). Everyday resilience also resists the idea that resilience is a fixed, innate quality, suggesting instead that it is shaped by the social, cultural, and intellectual contexts of teachers' personal and professional environments (Allen et al., 2023). Adopting a social ecological perspective that is contextualized and cross-disciplinary can help identify opportunities to develop and support early career teacher resilience (Johnson et al., 2014).

Mansfield et al. (2016) developed an evidence-based systemic model of teacher resilience. The model identifies four key factors: personal resources (e.g., motivation, social emotional competence), contextual resources (e.g., relationships, support networks), strategies (e.g., time management, problem solving, work-life balance), and outcomes (e.g., well-being, job satisfaction, engagement). This study describes a professional learning experience that offers preservice teachers a strategy for developing resilience by spending time in natural environments with an intended outcome of well-being.

Natural Environments and Well-Being

A growing body of research suggests potential benefits from spending time in natural settings, both psychological and physiological. These include improved immune function, lower blood pressure, reduced anxiety and depression, increased attention, expanded social connections, improved sleep quality, and gains in creativity (e.g., Bragg & Atkins, 2016; Frumkin et al., 2017; Hansen et al., 2017; Kaplan, 1995). Globally, the health benefits of frequent nature contact are gaining traction, with governments such as Finland, Japan, Korea, and Scotland investing in the development of green spaces as preventive medicine (Greenspace Scotland, 2018; Koselka et al., 2019; Lee, 2012; Song et al., 2016).

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Four main theories describe the mechanisms underlying the potential benefits of natural environments. The biophilia hypothesis (Fromm, 1973; Wilson, 1984) arises from an evolutionary approach, suggesting that our affiliation with nature and other living organisms stems from a biological, historical connection of interdependence. The theory explains, for instance, why we often prefer to live near water or landscapes with mountain views. Support comes from studies suggesting urbanization and corresponding decreases in exposure to nature are associated with increases in mental health disorders, including depression and anxiety (Lederbogen et al., 2011; Strife & Downey, 2009). Biophilia is sometimes associated with Stress-Reduction Theory (SRT) (Ulrich et al., 1991) and contends viewing or spending time in unthreatening natural environments promotes recovery or restoration from stressful situations. The theory emerged from Ulrich's study of hospital patients, where those who had window views of nature recovered faster and with fewer pain medications than those with views of the built environment (Ulrich, 1984). *Shinrin-yoku* or "forest bathing," the Japanese practice of experiencing natural environments with all five senses, supports SRT from a physiological basis (Song et al., 2016) and contributes to the Phytoncide Hypothesis. In this theory, support comes from studies suggesting that phytoncides given off by trees have antibacterial, anti-inflammatory, and antifungal qualities which, when breathed in or absorbed through the skin, increase natural killer or NK white blood cells that can kill tumor cells and promote anti-viral defense (e.g., Anderson, et al, 2021; Li et al, 2009). In this way, spending time in natural settings, especially near trees, can strengthen the immune system. Attention Restoration Theory (ART) (Kaplan, 1995) suggests that natural settings restore attention by reducing stimuli and promoting "involuntary attention," which requires little or no effort and allows individuals to recharge and relax; conversely, urban contexts increase stimuli and require significant amounts of "voluntary attention," which requires effort and uses large amounts of glucose resulting in fatigue and decreased executive function capacity. A recent review of ART research identified working memory, cognitive flexibility, and to a lesser extent attentional control all improved following exposure to natural environments (Stevenson et al., 2018).

Little research exists around the intersection of natural environments and teacher mental health (Gulwadi, 2006). When nature and environmental education is included, it is often not prioritized or focuses primarily on academic curriculum rather than health and well-being (Meier & Sisk-Hilton, 2017). Since teachers' work lives "require significant attentional and emotional resources and their effective regulation" (Roeser et al., 2012, p. 168), research and experiences utilizing natural settings may be an untapped resource for helping teachers develop practices that promote resilience. This study addresses these gaps within the literature and professional practices.

Purpose

The purpose of this study is to determine the effects of time spent in natural environments on preservice teachers' well-being. The research questions are 1) what is the short-term effect of spending time in a natural environment on rumination and multiple aspects of mood as indicators of well-being, 2) do the effects of exposure to the natural environment vary compared to spending time in a simulated indoor professional development day, and 3) to what extent does experiencing the benefits of natural environments help preservice teachers develop a strategy to support their own well-being? For this study, we examined differences in change over two days, one in a natural environment and one in a simulated professional development setting, with a follow-up questionnaire on behavior changes four months later.

Methods

Participants

All 20 candidates completing a one-year cohort model Master of Arts in Teaching (MAT) program leading to teacher certification at a small liberal arts university in the United States were invited to participate in the study. This resulted in a sample of 16 preservice teachers (10 female, 6 male; mean age 22.8). Participants spent one day in a natural environment (NE) and one regularly scheduled day of classes/workshops at an urban university, designed to simulate a professional development (PD) day for teachers. Both days removed participants from the demands of teaching and students but intentionally varied in setting. Four months later, participants were surveyed regarding the experiences and their impact on strategies utilized to support their well-being. The NE and PD days took place

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during the first semester of clinical practice, during which participants spent four days each week teaching in urban schools and one day each week attending classes at the university. The follow-up survey took place during the second semester of clinical practice, during which participants taught five days a week in urban school settings and attended university classes one evening a week. The study researchers taught at the university, but none taught in the graduate program. MAT faculty supported the research by providing time within their curriculum for the experiences. As such, the study intentionally took an experiential approach, inviting preservice teachers to engage in partnered study of their own learning regarding well-being and natural environments. IRB approval was obtained from the university, and participants signed informed consent forms.

Locations and procedures

"Natural environment" was defined as a space with a preponderance of nature - living and non-living elements with minimal human impact (e.g., plants, non-human animals, hills) (Frumkin et al., 2017). The NE day took place in a state park approximately one hour from the university in a natural setting of trees, trails, and a river with stair steps of limestone falls that allow hiking and climbing. The weather was cloudy with a high of 63 °F, and the park was not crowded. Before traveling to the park in vans, participants met at the university to learn about the purpose of the study, the plan for the day, and to collect pre-walk measures (see Rumination and POMS measures below). Once at the park, participants were led through a 30-minute guided forest experience inspired by forest therapy principles (Clifford, 2018), then provided a box lunch and allowed to spend the remainder of the day exploring the area alone or in small groups. They were instructed to limit technology usage to taking photos and keeping time and to not discuss teaching or students. Before leaving the park, participants completed post-walk measures. Total time at the park was approximately four hours.

The PD day took place in an indoor classroom with windows on a weekday during the fall semester. Participants spent approximately three hours in a morning class that utilized a combination of lecture and discussion, and three hours in the afternoon in a workshop format, collaborating with faculty and peers on projects and portfolios related to the morning's instruction and their clinical teaching placements. Accordingly, the PD context met criteria for effective professional development that is content-focused; incorporates active learning; supports collaboration; offers feedback and reflection; and is sustained (Darling-Hammond et al., 2017). Pre-PD day measures (Rumination and POMS) were collected at the beginning of the day before instructional components began, and post-PD measures were collected at the end of the day prior to departure. Participants were given no special instructions regarding technology use or discussion topic limitations and were allowed to leave the classroom, as well as campus, during lunch if desired.

After NE and PD data collection and analysis, researchers met with participants to share results and discuss possible reasons why results did/did not match findings from the literature. Four months later, participants completed a follow-up survey assessing the extent to which the experience informed their own use of natural spaces to support their well-being. Afterwards, aggregate results of the study were shared with participants.

Measures of well-being

Rumination was assessed using participants' self-reported levels using the Reflection Rumination Questionnaire (RRQ) (Trapnell & Campbell, 1999). The instrument evaluates factors of rumination and reflection, both of which are independent tendencies of self-attentiveness. While both scales may indicate increased levels of introspection and knowledge of self, rumination focuses on negative, self-relational emotions found predictive of depression and other mental disorders (Ghaznavi & Deckersback, 2012; Law, 2005). We chose to use the rumination scale of the RRQ as it is psychometrically sound and predictive of three dimensions of psychological well-being - autonomy, environmental mastery, and self acceptance (Harrington & Loffredo, 2010). Additionally, this section of the RRQ has been used in studies to evaluate causal changes in rumination associated with natural environments (Bratman et al., 2015). The 12 items measure ruminative tendencies (e.g., "I spend a great deal of time thinking back over my embarrassing or disappointing moments"), with each statement rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Increased means

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of the summed scores indicates higher degrees of rumination or more worried thoughts.

The Profile of Mood States (POMS) is an instrument widely used to assess short-term changes to mood, as well as psychological and emotional well-being (e.g., Morfeld et al., 2007; McNair et al., 1971; 1992). Participants rate items on a Likert scale ranging from 0 (not at all) to 4 (extremely). In addition to a general mood indicator, there are six resulting dimensions: Tension-Anxiety (T), Depression-Dejection (D), Anger-Hostility (A), Vigor-Activity (V), Fatigue-Inertia (F), and Confusion-Bewilderment (C). Grove and Prapavessis (1992) validated a shortened version of the POMS and included a seventh dimension, Esteem-related Affect (E), to capture a positive aspect of emotion that may not be indicated on the original version. Summing the negative subscales (T, D, A, F, C) and subtracting the positive subscales (V and E) generated a total mood disturbance score. While originally designed for use with athletes, the POMS has been used with confidence in studies addressing changes in mood in natural settings (Lee et al., 2014; Li et al., 2009; Perkins et al., 2011). Based on the strong history of reliability and validity, as well as the acceptance of this instrument in similar studies, the POMS was selected to evaluate changes in mood as an indicator of emotional well-being.

Four months after the NE and PD days, participants completed an in-person 10-item survey administered by MAT faculty about how the experience impacted well-being strategies. Seven items asked participants to rank their level of agreement on a four-point Likert scale from 4 (strongly agree) to 1 (strongly disagree) with statements, such as "I have intentionally visited a natural area at least once to support my well-being". The last three items were open-ended to provide a qualitative understanding of contextual factors influencing preservice teachers' ability and willingness to utilize natural environments as a well-being strategy. These items asked, 1) "What was your most important take-away from this experience?", 2) "If you have not spent time in natural areas or outdoors, please share with us the primary reason," and 3) "Please share any additional feedback with us". This brief feedback survey was developed by the researchers. Quantitative items were not validated, but rather were used as a reference to better understand qualitative responses.

Analysis

The analyses proceed in two parts. We first examine any differences in each outcome variable before and after exposure to the NE and PD conditions using a series of hypothesis tests (see Table 1). Since there are only 16 participants, the sample size is not sufficient to ignore the assumption of normality in the distribution of the pre-post differences that is required to conduct a parametric hypothesis test. Thus, we assess the normality of these distributions using a series of Shapiro-Wilk tests. For seven of the nine outcome variables, there is no evidence of non-normality in the distribution of pre-post differences (in both the NE and PD conditions). For these variables where it is safe to use parametric tests, we use paired sample t-tests to assess whether observed changes in outcomes from pre to post exposure are statistically significant. For the POMS measures of Depression (in the PD condition) and Anger-Hostility (in the NE and PD conditions), the Shapiro-Wilk tests provide evidence that the distribution of pre-post differences is not normally distributed. For the variables where a non-parametric test is required, we use a Wilcoxon Signed Rank Test to assess the statistical significance of the changes in outcomes from pre to post exposure. The results of all pre-post comparisons are robust to the use of both parametric and non-parametric tests. The alpha for all statistical tests is set at .05.

In the second part of the analysis, we examine the extent to which the effects of the timing of exposure (measured before and after) varies between the two experimental conditions (NE and PD). Since both time and condition are within-subjects factors, we assess the statistical significance of the interaction between these factors using two-way repeated measures ANOVA tests for each outcome variable. A key assumption of this parametric test is that outcomes must be normally distributed for each combination of the two within-subjects factors (as above, this assumption is especially strict due to the small sample size). We assess this assumption using a series of Shapiro-Wilks tests of normality. For six of the POMS outcome variables (Tension-Anxiety, Confusion-Bewilderment, Depression, Anger-Hostility, Fatigue-Inertia, and Total Mood Disturbance), there is evidence of non-normality. To address this issue, we use the Aligned Rank Transform (ART), a nonparametric two-way (aka factorial) ANOVA procedure for these variables (Leys and

Schumann, 2010). In contrast to other nonparametric approaches, the ART is useful in situations where the objective is to evaluate potential interaction effects (Higgins & Tashtoush, 1994; Wobbrock, Findlater, Gergle, & Higgins, 2011). The results of both the parametric and nonparametric ANOVA analyses are summarized in Table 1.

Table 1

Results of t-tests and ANOVA analysis for nine measures of well-being (n = 16)

Rumination score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	3.59	2.88	0.71	-4.85***	
Professional Development [a]	3.35	3.19	0.17	-2.27*	
Time * Condition ANOVA [c]					15.88**
POMS Tension-Anxiety score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	7.13	1.63	5.50	-6.15***	
Professional Development [a]	5.75	5.38	0.38	-0.45	
Time * Condition ANOVA [d]					17.85***
POMS Confusion-Bewilderment score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	3.88	1.38	2.50	-6.12***	
Professional Development [a]	3.38	3.63	-0.25	0.51	
Time * Condition ANOVA [d]					28.27***
POMS Depression score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	1.63	0.56	1.06	-2.64*	
Professional Development [b]	3.19	2.25	0.94	-1.89	
Time * Condition ANOVA [d]					3.66
POMS Anger-Hostility score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [b]	0.81	0.25	0.56	-1.38	
Professional Development [b]	1.63	3.19	-1.56	1.39	
Time * Condition ANOVA [d]					3.23
POMS Fatigue-Inertia score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	6.19	4.19	2.00	-1.77	
Professional Development [a]	5.00	5.50	-0.50	0.58	
Time * Condition ANOVA [d]					3.35
POMS Vigor-Activity score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	8.19	7.56	0.63	-0.61	
Professional Development [a]	6.56	4.50	2.06	-3.03**	
Time * Condition ANOVA [c]					2.92
POMS ERA score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	14.06	16.50	-2.44	2.80*	
Professional Development [a]	14.44	12.56	1.88	-2.42*	
Time * Condition ANOVA [c]					14.52**
POMS Total Mood Disturbance score	**Pre**	**Post**	**Difference**	**t**	**F(1,15)**
Natural Environment [a]	-2.63	-16.06	13.44	-4.59***	
Professional Development [a]	-2.06	2.88	-4.94	1.63	
Time * Condition ANOVA [d]					22.83***

[a] Paired sample t-test of the difference between pre/post treatment

[b] Wilcoxon signed rank test of the difference between pre/post treatment

[c] Results of two-way repeated measures ANOVA

[d] Results of a nonparametric Aligned Rank Transform (ART) two-way repeated measures ANOVA

* $p < .05$ ** $p < .01$ *** $p < .001$

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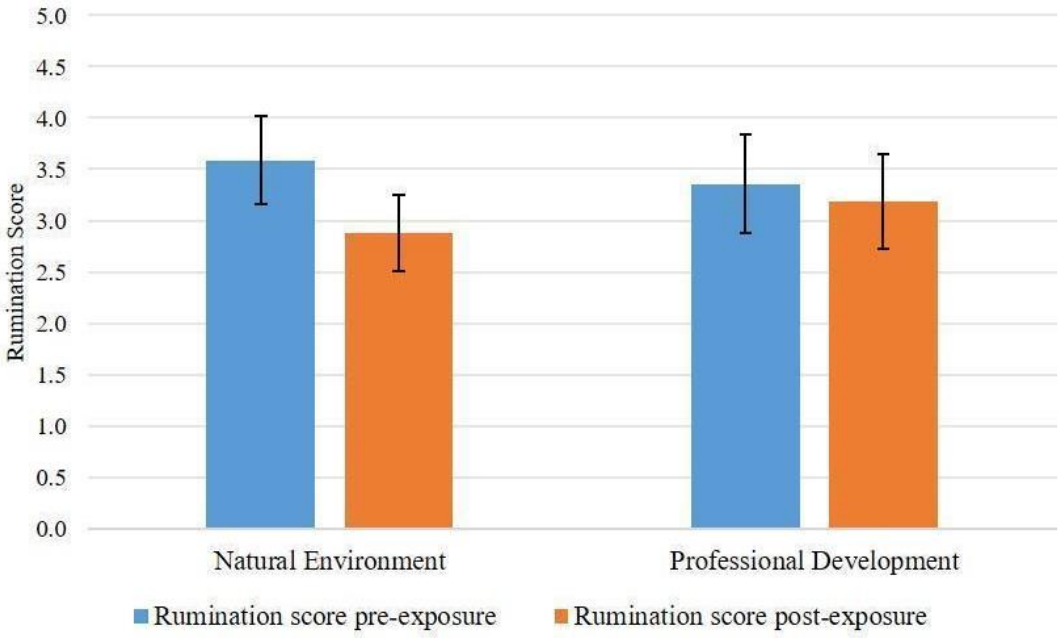
Figure 1a

Rumination Score Pre- and Post-Exposure in NE and PD Conditions (n=16)



Results

Figure 1a displays the average change in Rumination score from pre to post exposure for the NE and PD conditions. As shown in the figure, the Rumination score decreased from 3.59 to 2.88 after exposure to the NE condition (a 19.8% reduction). Table 1 presents the results of a paired sample t-test and indicates that this difference is significant at the .05 level (p <.001). In the PE condition, the Rumination score decreased significantly, but the decrease (4.8%) was smaller in magnitude than in the NE condition. We assess whether the change from pre to post exposure on Rumination score varied significantly across the two conditions using a two-way repeated measures ANOVA test (see Table 1). This analysis reveals a significant interaction between time and experimental condition [$F(1,15) = 15.88$, $p = .001$]. The change from pre to post exposure is significantly different between the NE and PD conditions, supporting the idea that time spent in a NE had a greater effect on rumination than time spent on PD activities.

Table 1 displays the difference in the average POMS Tension-Anxiety subscale scores from pre- to post-exposure in both conditions. Tension-Anxiety declined by 5.5 points (a 77% reduction) after exposure to the NE condition. In contrast to this notable and statistically significant ($p < .001$) reduction, Tension-Anxiety declined by only .38 points in the PD condition (this change is not significant). This result provides a dramatic example of differential effects between the two conditions: Tension-Anxiety was substantially reduced in the NE condition but not the PD condition. This is supported by the ANOVA analysis in Table 1 which highlights a significant interaction between time and experimental condition [$F(1,15) = 17.85$, $p = <.001$].

We observe a similar pattern in the POMS Confusion-Bewilderment scores. As shown in Table 1 Confusion-Bewilderment declined by almost 52% from pre to post exposure in the NE condition. This change is significant ($p < .001$). In contrast, scores actually increased slightly after exposure to the PD condition, though this change is not significant. The ANOVA analysis supports the idea that the change from pre to post exposure differed significantly between the two conditions [$F(1,15) = 28.27$, $p < .001$]. This highlights another outcome for which the preservice teachers in our sample benefitted from time spent in the NE condition.

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Table 1 shows the change in the average POMS Depression subscale scores from pre to post exposure in both conditions. As shown in the figure, Depression was reduced after exposure to both conditions. For the NE condition, depression declined by 1.06 points (a 65.6% reduction), and this reduction is significant (p = .019). The absolute reduction in the PD condition was of similar magnitude (.094 points, a 29.5% reduction), but this estimate is less precise and the difference is not significant (p = .071). The ANOVA analysis does not provide evidence of a significant interaction between timing of exposure and condition [F(1,15) = 3.66, p = .075]. These results suggest that the time spent in a natural environment did reduce POMS Depression scores. However, the available evidence is not sufficient to support the idea that the effect of exposure on depression was different compared to the time spent in PD activities.

We also assess the effects of exposure to the NE and PD conditions on POMS Anger-Hostility and Fatigue-Inertia subscale scores. For both outcomes, there was a reduction in the NE condition and an increase in the PD condition (see Table 1). However, these estimates are imprecise, and none of the changes are significant. The ANOVA analyses are also unable to establish a significant interaction in the effects of exposure across the two conditions. Thus, although the observed results for Anger-Hostility and Fatigue-Inertia may be consistent with benefits of time spent in a natural environment, further analysis (with a larger sample) is required to determine if these patterns are statistically significant.

The POMS instrument also includes a subscale measuring Vigor-Activity. Although prior research is inconclusive on the anticipated and observed effects of exposure to nature on this outcome (Lee et al., 2014; Li et al., 2009; Perkins et al., 2011), we include Vigor-Activity in order to provide a comprehensive assessment of the effects of the two conditions on all seven POMS subscales. As shown in Table 1, Vigor-Activity went down slightly after exposure to the NE condition. However, the estimates of this outcome both before and after exposure are imprecise and the reduction is not significant (p = .549). In contrast, Vigor-Activity scores declined significantly in the PD condition (p = .008). The ANOVA analysis does not provide evidence of a significant interaction [F(1,15) = 2.92, p = .108]. These results suggest that time spent in the PD condition reduced POMS Vigor-Activity scores, but further analysis is required for a more conclusive statement about the effect of time spent in nature.

The POMS Esteem-related Affect (ERA) subscale captures positive aspects of emotion. As shown in Table 1, ERA improved by 17% from 14.06 to 16.50 after exposure to the NE condition, and this change is significant (p = .014). The effect of exposure in the PD condition works in the opposite direction. In this condition, ERA declined significantly from 14.44 to 12.56 (p = .029). Consistent with this observed difference, a two-way repeated measures ANOVA analysis provides evidence of a significant interaction between condition and timing of exposure [F(1,15) = 14.52, p = .002]. These results provide clear evidence that time spent in the NE condition improved Esteem-related Affect while time spent in the PD condition had a negative effect.

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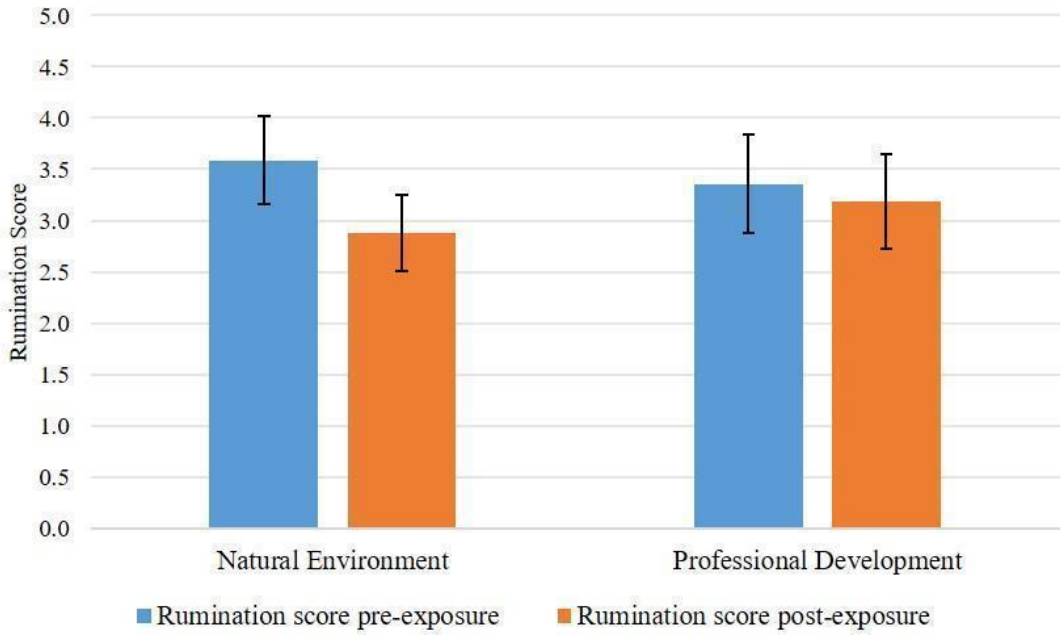
POMS Vigor-activity
Figure 1b

POMS Total Mood Score Pre- and Post-Exposure in NE and PD Conditions (n=16)



Bars represent the 95% confidence interval

The POMS Total Mood Disturbance score aggregates information from all the POMS subscales into a composite measure of mood. Negative values correspond to "better" moods. Figure 1b displays the change in POMS Total Mood Disturbance score from pre to post exposure for both conditions. Table 1 shows that the average score improved substantially from -2.63 pre exposure to -16.06 post exposure in the NE condition (a 510% improvement). This change is significant at the .05 level ($p < .001$). In contrast, there is evidence that Total Mood Disturbance score worsened slightly from -2.06 to 2.88 in the PD condition, but these estimates are imprecise, and the change is not significant. Table 1 also shows the results of the ANOVA analysis. The interaction between time and experimental condition is significant [$F(1,15) = 22.83$, $p < .001$]. This indicates that the change from pre to post exposure differed significantly between the NE and PD conditions. Preservice teachers experienced a notable improvement in mood after time spent in a natural environment, and there is evidence that this effect varies across conditions.

Follow-up survey

The follow-up survey measured the impact of the NE and PD days on preservice teachers' development of resilience practices four months later. Findings illustrate that participants feel that spending time in natural settings improves their well-being and that they plan and are willing to spend time in nature; however, fewer have actually done so in the past four months. Responses indicate that the most important take-aways from the experience were the importance of intentional self-care and nature-as-healer. One participant stated, "I've always had in mind that taking breaks and nature was helpful and necessary, but this experience provided a much clearer picture of how essential this is for me. Having a research-based explanation contributed to this." Another shared that, "I don't feel guilty not spending time working to spend a moment outside anymore." The primary reason participants had not spent time in natural areas or outdoors focused on a lack of time, including being "too busy with homework" and "heavy school work" loads. Others had not spent time in nature because they had no one to go with, it was outside their normal routine, they already participated in organized

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outdoor sports, parks lacked Wi-Fi, or weather conditions were poor. General feedback included statements such as, "I wish we had another day planned for us to go as a class to hike somewhere or just a park nearby to feel refreshed," and "I loved this experience, and I think it should become more of a standard thing for people who enter into the program." To move from knowledge that spending time in natural environments supports well-being to regularly practicing nature-based self care, the learning needs to be sustained and supported with additional NE days and well-being sessions.

Discussion

Our results indicate that natural environments may reduce rumination and improve mood. Participants' NE experience produced significant reductions in rumination as well as mood factors of Tension-Anxiety, Confusion-Bewilderment, and Depression, and increases in Esteem-related Affect and Total Mood Disturbance. Comparisons between the NE and PD conditions indicate significantly different effects of nature exposure on rumination, Tension-Anxiety, Confusion-Bewilderment, Esteem-related Affect, and Total Mood Disturbance, but not Depression. No significant differences were found in either condition for Anger-Hostility, Fatigue-Inertia, or Vigor-Activity. These findings are consistent with prior research on time spent in natural environments compared to urban settings that report decreases in rumination (Bratman et al., 2015), Tension-Anxiety (Lee et al., 2014; Perkins et al., 2011), Confusion-Bewilderment (Lee et al., 2014), and Depression (Perkins et al., 2011).

Increased rumination, self-attentiveness focused on threats, losses, or injustice (Trapnell & Campbell, 1999), often promotes negative emotions shown to predict the onset of mental disorders (Ghaznavi & Deckersbach, 2012), including depression (Nolen-Hoeksema, 2000). While the interaction between the NE and PD conditions for the POMS depression measure was not significant in this study, the changes in rumination levels indicate that depressive tendencies may be addressed by spending time in nature. While further research is required to assess the effects on depression, the observed changes in rumination, Tension-Anxiety, Confusion-Bewilderment, Esteem-related Affect, and Total Mood Disturbance indicate that time spent in natural environments may improve emotional well-being.

While differences in Anger-Hostility and Fatigue-Inertia were not statistically significant, the observed results still followed expected patterns decreasing in NE and increasing in PD. The Vigor-Activity subscale decreased in both conditions. When validating the short form, Grove and Prapavessi (1992) noted this subscale was not as "straight-forward" as others and that there may be some interpretation differences among respondents (p. 104). Given imprecise results and our focus on rumination and mood, the Vigor-Activity scores do not appear to provide meaningful data for evaluating the research questions.

The research design allowed preservice teachers to experience these effects first hand. During feedback sessions, the theme of awareness surfaced. This included awareness of the benefits of natural environments and well-being, as well as the effect differences between the NE and PD days. Some participants also found that the research-based experience gave them the necessary justification or even permission for spending time outside. These factors, however, were not sufficient for most preservice teachers to make spending time in nature a well-being strategy. In short, attempting to add to an already demanding schedule was ineffective.

While the PD day afforded collaborative opportunities and a break from typical teaching and student demands, it did not provide the restorative benefits of the NE. This may not be surprising given the focus of the NE day was well-being, while the focus of the PD day was primarily curricular. However, the significance of the findings is not simply that a day in nature contributes to greater well-being, it is also that teachers in a PD experienced some declines in measures of well-being. This dichotomy presents an important opportunity. We ask educator preparation programs to carefully consider how they use PD days. The status quo use of PD days as a space for curricular work may not be the best use of time if the profession wishes to support the whole educator as well as the whole child. Instead of focusing exclusively on curricular work and building teacher skill sets, might a portion of PD time be better spent supporting teachers' well-being and combating burnout and attrition, which in turn, supports student outcomes?

This study provides initial evidence for exploring nature as a strategy for supporting preservice teacher well-

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being. Despite a small sample, we found large and statistically significant effects for multiple measures. In a recent study, Passmore et al., (2022) detail the under-utilization of nature as a pathway for well-being, despite growing evidence of the benefits. They note several reasons for this, including the false belief that nature is something "far away" in a "wilderness setting," providing findings from two randomized studies (Heilmayr & Miller, 2020; Passmore & Howell, 2014) that found "the most common settings for this increased nature activity were participant's own backyards (43%) and neighbourhoods (29%)" (Passmore et al., 2022, p. 3). Other research also found benefits not only in expansive areas of wildness but in urban parks and green landscapes within city centers (e.g., Gao et al., 2021; Song et al., 2015; Song et al., 2016; Yuen & Jenkins, 2019). Moreover, implementing nature as a well-being strategy does not require large blocks of time. Some studies found advantages for spending as little as 20 minutes in natural settings (e.g., Perkins 2011). Research into the exposure and dose effects suggests spending 120 minutes in nature each week, whether cumulative or during one visit, may be a key threshold for health and well-being, with gains peaking between 200-300 minutes (White et al., 2019). Taken together, employing nature may be a simple, accessible, and cost-effective strategy to support preservice teacher well-being.

While conditions during the COVID-19 pandemic prevented efforts to scale up the research, advancing the discussion of supporting teacher psychological and emotional well-being has never been more urgent. A recent Gallup poll (Marken & Agrawal, 2022) reports that 44% of K-12 workers and 52% of teachers in the U.S. say they "always" or "very often" feel burned out at work, a rate higher than all other industries. A 2022 National Education Association survey (Walker, 2022) found that 55% of U.S. teachers plan to leave the profession earlier than planned, with percentages higher for teachers of color. Benson (2017) suggests that while educators have begun to identify strategies and resources to support students with mental health illness, schools have yet to create the necessary structures to support the teachers who work with these students, expecting teachers "to make time and space on their own to find support and develop coping mechanisms" (p. 39). In her work on teacher and staff well-being, McCallum (2021) argues that children and adolescents cannot be well unless their teachers are well too. Furthermore, teacher stress, whether perceived or actual, impacts teacher well-being and thus, the recruitment and retention of high-quality teachers. Given the known impact of teacher quality on student achievement (e.g., Hattie, 2008), we ask the fundamental question, "In the 21st century, what does it mean to prepare a high-quality teacher?" In a recent speech, US Education Secretary Michael Cardona stated, "As we support the whole child, we must also support the whole educator" (Camera, 2022). Day and Gu (2014) write that teaching in the 21st century "requires higher levels of intellectual and emotional energy than ever before" (p. 16) and recommend teacher resilience development begin in initial preparation programs and continue throughout teachers' professional lives. While barriers to doing so are many, perhaps the main obstacle for preparation programs is an already overflowing teacher education curriculum largely dictated by accreditation, certification, and licensure requirements. In a discussion of the need for administrators to prioritize teacher mental health, Indihar (2022) states, "We may not be able to create more time for teachers, but we can protect the time they do have and set some aside for learning about evidence-based well-being strategies" (p. 2). We advocate doing the same by furthering the discussion and offering nature as one avenue for supporting preservice teacher well-being.

Limitations

While the study benefits from being an ideal population of interest available on three separate dates, this necessitated a small sample size. This has consequences for the precision of the estimates and may contribute to the insignificant interactions observed for Anger-Hostility, Fatigue, and Vigor-Activity. Moreover, the study did not control for physical activity, which is associated with overall general and mental health benefits (Penedo & Dahn, 2005). Participants in the NE condition (walking, hiking) were more physically active than during the PD condition (primarily sitting) and engaged in varying levels of physical activity during the NE condition (some hiking while others sat for periods of time). While some of the effects may be due to the contributions of being physically active, studies have found an added value of being physically active specifically in natural settings related to health and well-being (Pasanen et al., 2014; Shanahan et al., 2016). Finally, the research design requires that participants be aware of

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study questions and assumptions which can increase response bias.

Conclusion

This study offers important implications for practice. Supporting teacher well-being should be a priority and essential component of preparing and sustaining high-quality teachers for 21st century schooling contexts. Allocating time in natural environments is one potential strategy for doing so that is both accessible and affordable. Schools concerned with losing valuable professional development time may consider combining the option of a morning outside followed by an afternoon of indoor work. Doing so may fulfill both the well-being needs of teachers and the academic needs of the profession. Future studies need to identify additional practices and models that impact the development of teacher resilience and support well-being. Moreover, standards and policies governing the teaching profession need to reflect the needs of teachers by including well-being outcomes, for adults as well as for students, and identify aspects of the curriculum that can be minimized to do so.

Only when teachers are able to take care of themselves can they also maintain the necessary capacity to appropriately meet the growing needs of P-12 students. This study, which demonstrates that creating space for teachers outside of the classroom in a natural area has greater impact on their rumination practices and various aspects of mood than similar time away from the classroom in PD contexts, makes an important contribution to the teacher education literature.

Conflict of Interest

The authors declare no conflict of interest.

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