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NATURE AS A LIVING LABORATORY FOR TEACHING RESEARCH METHODS IN PSYCHOLOGY

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DOI: https://doi.org/10.5281/zenodo.17141997

ABSTRACT: Making research tangible is highly impactful in the teaching and learning of research methods in psychology. Using nature as the context and content for learning may be a novel, accessible, and effective way of teaching the research process. We explored the viability and impact of applied nature focused coursework on students' understanding of research curriculum. During the term, twenty-nine students in two capstone courses met weekly and discussed relevant sustainability research and the outdoor course collected environmental data while walking outside. Students were given a research methods pretest/ posttest as well as article reviews to assess mastery of research throughout the term. We found significant improvement in students' research mastery in both courses from the beginning to the end of the term, suggesting nature-related research as an effective avenue for teaching these concepts. Additionally, the outdoor course significantly outperformed the indoor course. We discuss using hands-on activities grounded in nature exploration as innovative and effective teaching methods for research methods.

Keywords: Learning, Nature, Research Curriculum, Hands-on learning

1. Introduction

We designed the current study to investigate the viability and impact of hands-on sustainability-focused coursework on college students' understanding of the research process and application of research to their daily lives. This exploration of research methodology centered on outdoor experiences is important for the scholarship of teaching because it may provide a way for instructors to introduce psychological concepts in a way that feels tangible, and provides a concrete, hands-on method of testing theories learned in class. Students across disciplines are shown to demonstrate better memory and understanding when they actively participate in their learning (Arthurs &Kreager, 2017). Therefore, this investigation took students out of the classroom, placed them in an open-access, local environment where they could actively research concepts from coursework. Nature and outdoor activity have the potential to be highly impactful on students' overall quality of life (e.g., Bowen & Neill, 2013; Harper, 2017), and exploring concepts related to sustainability in research coursework may encourage

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individual nature exploration. Making research tangible, grounding it in relatable examples, and providing something students can sense – beyond reading about scenarios – is highly impactful for learning (e.g., Cook, 2008; LaCosse et al., 2017; Nind& Lewthwaite, 2018; Smith, 1998; Snee, 1993; Yoder, 1979). This is especially important for material that requires application, such as the scientific method taught in research courses. Concepts related to research methods and statistics are often the most difficult for psychology majors to master, especially at small universities with limited lab experience opportunities (Harlow et al., 2002). When individualized lab experiences are not available, scientific reasoning skills are taught predominately in the research methods and statistics courses.

Although most instructors of research courses believe the courses are essential for fostering students' critical thinking skills, students often do not engage with or enjoy the content or objectives of the course (Ciarocco et al., 2013; Sizemore & Lewandowski, 2009). Therefore, the skills acquired by conducting and evaluating research may be lost on students who report unfavorable opinions of the course (Vittengl et al., 2004).

Fortunately, there are pedagogical techniques that can be used to help students engage with research methods material. Experiential education, according to Kolb (1984) and Dewey (1986), situates experience at the core of learning. Accordingly, learning is only effective when certain abilities, "concrete experience, reflective observation, abstract conceptualization, and active experimentation," are mastered (Kolb, 1984, p. 30). These abilities are best practiced when hands-on research is intentionally incorporated throughout a course. Critically examining articles, participating in others' research, developing unique research questions, and collecting data gives students the opportunity to learn concepts based on their manipulations (Ciarocco et al., 2013). By providing a way to connect research to the real world, and providing that opportunity within a required course, such as research methods or a senior capstone, we can give students hands-on experience doing the research they read about. While there are many avenues for providing a hands-on learning experience (Arthurs &Kreager, 2017), the use of outdoor experience and nature related content has not been formally explored as a pedagogical technique for teaching the research process.

1.1. Nature-Related Curriculum

Hill and Wang (2018) suggest that sustainability curriculum in general education promotes interdisciplinary interaction at a university level and fosters critical inquiry skills for students. Although these outcomes matchmany university's goals for their graduates, methods for integrating nature-related research (e.g. investigations of heat vulnerability, climate gentrification) into university curricula have not been straightforward for disciplines outside of environmental science or ecology (Reid &Petocz, 2006). Integrating nature focused information into psychology course-workmay be possible by directing attention to nature's benefits for mental health. Such research shows that humans can experience positive mental and physical health effects by engaging in the accessible, often free, practice of being outdoors (e.g., Bratman et al., 2019; de Vries et al., 2003; Frumkin, 2001; Rugel et al., 2019; Tzoulas et al., 2007). Japanese researchers have identified the benefits of spending time in nature as a process called shinrin-yoku(forest bathing; Park et al., 2010). Their data show that forest bathing, immersing oneself in nature for 20 minutes, can reduce blood pressure, lower stress, improve cardiovascular health, lower blood sugar, and improve immune function (Park et al., 2010; Wen et al., 2019). A review by Bowler and colleagues (2010) reveals that exposure to natural environments, typically lasting one hour or less, improves psychological factors such as mood and attention beyond the benefits of exercising.

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Because of the cited benefits of engagement with nature, we focused our course content and context on environmental research to provide college students an opportunity to investigate the intersection of psychology and sustainability and to practice intentional engagement with the natural world. First, we hypothesized that sustainability-focused research can provide a unique, grounded, effective way of exploring the scientific research process with students and would improve students' understanding of research methods by the end of the course. Additionally, we hypothesized that students enrolled in the hands-on course (the outdoor course) would outperform students in a course with the same content but without the hands-on outdoor activities (the indoor course). This novel methodology was designed to engage students and maximize their competencies as compared with the status quo - students confined to a classroom.

2. Method

2.1. Participants

The research objectives were explored in two sections of a senior capstone course. There were 13 participants (7 women, 6 men) in the outdoor course and 16 participants (7 women, 9 men) in the indoor course. Students were senior psychology majors or minors who completed the course as a graduation requirement. Students enrolled in the generic capstone course without knowing the topic, assigned instructor, nor course structure.

2.2. Measures

A research pre- and posttest assessed the efficacy of the course in building students' comprehension and application of psychological research. Questions on the research methods pretest/posttest were adapted from the GRE Psychology subject test. The test focused on students' understanding of research terms, situations, and ethical guidelines and consisted of 13 items ($\alpha = .88$). Students also completed questionnaires that assessed their understanding of research design and statistical findings for each empirical article read in class.

The questionnaire asked students to identify: the independent and dependent variable(s) in the studies, the hypothesis or hypotheses, the significance of the results in relation to the hypothesis, and limitation in the design used. A teaching assistant blindly scored these responses using rubrics to assess mastery (Below expectations = 1-2 points, Meets expectations = 3-4 points, or Exceeds expectations = 5 points).

2.3. Procedure

The capstone course lasted 15 weeks and met once each week for 75 minutes. The indoor class met in the classroom for all 15 sessions. The outdoor class met in the classroom for instruction for 10 sessions and in different local outdoor locations for 5 sessions. The outdoor sessions were in various city and county parks averaging 200 acres of wooded land.

2.3.1. In-Class Sessions

On each in-class day, students read peer-reviewed articles about nature-related topics before class (see Appendix for citations). The instructor concentrated each in-class conversation on: the methods described in each paper, including independent and dependent variables and hypotheses; how the research could be recreated in our local environment; and the ethical considerations made in each study.

2.3.2. Outdoor Sessions

On each outdoor day, the class was driven toa park located within 15 minutes of campus, the instructor asked students to walk silently for 20 minutes (following guidelines from Li, 2018) and: collect specific data from their environment that corresponded to an article they had read before class (e.g., tree cover, park attendance);suggest

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a research question, including independent and dependent variables, and hypothesis that could be studied in this specific environment; and consider the ethical implications of their questions. At the specified end time, students congregated to finish their research directives. The instructor spent the remaining time discussing each research design, and their psychological tie, with all students.

2.3.3. Tests of Research Material Mastery

All students were given a research pretest before the first day of class and a posttest on the last day of class. Their responses were collected online through the university's learning management software. Additionally, we assessed students' understanding of an empirical article at the end of each in-class session for both courses using the described questionnaire and mastery rubric.

3. Results

3.1. Research Pretest/Posttest

We analyzed the research methods focused pre-and posttest data using nonparametric Wilcoxon signed rank tests. Results indicate that students in the outdoor course performed significantly better on the posttest (Mdn=68.42%) compared to the pretest (Mdn = 32.60%), W = 91.0, p< .001. Students in the indoor course also performed significantly better on the posttest (Mdn = 49.70%) compared to the pretest (Mdn = 29.73%), W = 136.0, p< .001. A Mann-Whitney test showed that there was a significant difference between the outdoor (Mdn = 68.42%) and the indoor courses (Mdn = 49.70%), U= 133.5, p = .02.While both groups performed better after learning for a full semester, students in the outdoor course performed significantly better at the end of the term than students in the indoor course.

3.2. Mastery Measures

We analyzed the mastery scores, created by assessing students on aforementioned rubrics, for the outdoor and indoor courses using nonparametric Friedman's tests, comparing overall rubric scores at the beginning and the end of the semester. Time had a significant effect on mastery in the outdoor course, $\chi 2$ (11) = 146.34, p<.001. Pairwise comparisons showed that scores improved from time one, where the average student was below the mastery expectations, to time fifteen, where the average student was meeting, if not exceeding, the mastery expectations t (168) = 5.29, p< .001.Results from the indoor course also indicate that time had a significant effect on mastery in the indoor course, $\chi 2$ (14) = 120.97, p<.001. Pairwise comparisons showed that scores improved from time one, where the average student was below the mastery expectations, to time fifteen, where the average student was meeting the mastery expectations t (210) = 5.07, p< .001.

Difference scores were calculated for each student in the outdoor and indoor courses using the pretest (Rubric one) and posttest (rubric fifteen) scores. Because data were not normally distributed, we conducted a Mann-Whitney test. It showed no significant difference among the calculated difference scores in the outdoor group (Mdn = 2) and the indoor group (Mdn = 2), U=128.5, p= .26. Although scores were higher in the outdoor course, the difference scores between the outdoor and the indoor courses were not significant.

Finally, and most notably, mastery scores were compared between the courses at the weekly time points in which the outdoor course participated in the outdoor activity and the indoor course completed an in-class activity (weeks 2, 4, 8, 11, and 14). Mann-Whitney tests showed that significant differences between the outdoor and indoor courses at each of these time points (See Table 1). Students in the outdoor course performed significantly better than those in the indoor course for these five key hands-on time points.

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Table 1 Differences in Weekly Paper Rubric Scores for Outdoor Activity Timepoints

Week	Outdoor	Indoor	U	p
Week 2	Mdn= 2	Mdn= 2	149.00	.025
Week 4	Mdn= 3	Mdn= 2	182.50	<.001
Week 8	Mdn= 4	Mdn= 3.5	167.00	.004
Week 11	Mdn= 4	Mdn= 2	204.50	<.001
Week 14	Mdn= 4	Mdn= 4	170.00	.002

4. Discussion

Thispilot study providesquasi-experimental evidence for using nature-related research materials, especially where it is possible to use them hands-on, to promote learning of research methods for students of psychology. Our first hypothesis that students would improve their understanding and application of research methods in psychology from the beginning to the end of the term was supported. This suggests that nature-related research is an effective avenue for teaching research methods. Second, our hypothesis that students in the outdoor course would outperform students in the indoor course was supported by significantly higher posttest scores and significantly higher mastery scores resulting from the "hands-on," lessons for those in the outdoor course.

Students' ability to identify key variables and suggest changes in methodology steadily improved in their article analyses each week, significantly in most cases, for both courses. However, those in the outdoor course had higher overall mastery scores than those in the indoor course. This was especially true when the students in the outdoor course spent time outdoors collecting data that explored a concept from the article they read while also benefiting from moments of outdoor activity. The students in the indoor course read the same article and responded to the same prompts but did not get the hands-on experience of data collection, nor the potential enjoyment of being outdoors. Therefore, we suggest that nature-related articles, and the opportunities they present to collect data in a local environment, provide an experiential and accessible way of learning research methods that can be added as a research module within any course.

Students were more knowledgeable about research, both identifying concepts and applying them in the real world, after completing the course. We do not claim that students' increased understanding of research methods was a direct result of the specific content – e.g., sustainability / nature research. Ostensibly, students would have learned research concepts through other subfields such as consumer behavior or kinesiology, for example. Future work could compare the efficacy of these specific content areas for teaching psychological research methods. Additionally, the hands-on component of the research was enmeshed in the nature-related content and context for the outdoor group. However, the goal was to examine interactions with the natural world as a method of gathering hands-on data, not to claim nature curriculum as the bestor only context for conducting research. Our outcomes support the idea that students can learn research content from, while participating in, the natural world. Therefore, the described approach for teaching research methodology is innovative such that it brings research outside - a familiar and accessible environment for college students and one that may also provide supplemental health benefits.

4.1. Limitations and Future Directions

Although the focus in the outdoor course was to practice the research methods students learned about in a natural environment, only a third of the course meetings were outdoors. This was due to financial and logistical

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constraints of shuttling the group off campus during a certain time of day. Ideally, students would spend 75% or more of the course outside and future courses should set that expectation before students enroll.

Additionally, we asked students to walk around silently for 20 minutes while collecting data. However, we did not stop them from walking together and some students engaged in conversation while walking. We cannot say if these conversations aided in the students' understanding of their research questions or diminished their ability to focus. Finally, because this was not designed as a course-level investigation and not an experiment, students were not randomly assigned to the two courses. Therefore, any differences in their performance on the posttest measures could be due to group differences in motivation, ability, or other factors. Future work should isolate these factors while increasing sample size.

It is important to note that students in this cohort were senior psychology majors or minors whom we expected had taken a research course prior to capstone. While improving from pretest to posttest, students still performed lower than we anticipated. We assumed their level of research knowledge would be higher than we observed at the beginning of the term. The low overall posttest averages could be due to a lack of focus on the type of questions asked on the pre- and posttest in the class discussion. It does appear that students did gain overall understanding of research but may need more practice applying the concepts.

Most psychology programs require research training, but students do not always perceive the skills taught as useful (Ciarocco et al., 2013). Fortunately, research has demonstrated that when students observe how to apply research skills to their everyday lives, engagement improves and learning feels more purposeful (Stoa et al., 2020). Future research should explore if increased self-efficacy over learning can be fostered using the outdoor curriculum described in this study. Students' seeing how they personally benefit from nature-engagement may help address the lack of motivation to learn or engage in instruction that has been cited in articles such as Lee and Hammer (2011) and Kumar and Khurana (2012).

Because research (Bowen & Neill, 2013; Bowler et al., 2010) has shown that individuals report more positive moods after engaging in short outdoor experiences such as forest bathing (Park et al., 2010), future incorporation of it in this hands-on research approach may present instructors with a way of teaching research methods that helps students develop a greater understanding of the connection between nature, psychology, and their personal wellness.

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