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Article

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Abstract: Outdoor, hands-on and experiential learning, as opposed to instruction-based learning in classroom, increases student satisfaction and motivation leading to a deeper understanding of the subject. However, the use of outdoor exercises in undergraduate biology courses is declining due to a variety of constraints. Thus, the goal of this paper is to describe a convenient, no-cost and flexible exercise using an on-campus botanical tour for strengthening specific knowledge areas of major plant groups. Its assessment on conduct and coverage, and student-perceived and actual knowledge gain is also described. Data presented derived from traditional biology undergraduates in sophomore year over nine fall and three spring semesters. Conduct and coverage was assessed using a summative survey including open-ended questions administered to 198 students. A pre- and post-exercise survey addressing 10 knowledge categories was administered to 139 students to evaluate student-perceived knowledge gain. Quiz grades from the on-campus tour exercise were compared with average quiz grades from two in-class plant-related labs of 234 students to assess actual knowledge gain. Each student reporting on the conduct and coverage indicated either one or a combination of outcomes of the exercise as positive engagement, experiential learning, or of interest. Student-perceived improvement was evident in all ten knowledge categories with a greater improvement in categories learned anew during exercise compared to subjects reviewed. Quiz grades from the exercise were >11% greater than quiz grades from the two in-class plant-related labs. Active learning with interest likely contributed to the increased perceived and actual knowledge gains. Suggestions for adoption of the exercise in different settings are presented based on both student comments and instructor's experience.

Keywords: teaching biology outdoors; student engagement; experiential learning; plant classification; biodiversity

1. Introduction

Student satisfaction, the favorability of students' subjective evaluation of the experience and outcome of what they learned [1], and motivation are positively correlated to a variety of learning measures [2]. However, finding a match between what makes students satisfied and motivated and what needs to be covered in a specific biology course to meet program goals and standards is a challenge. Such matches, if found, will increase student-driven learning, rather than passive reception. Pleasurable experiences with our outdoors and resulting curiosity are among the reasons why many of us, today's biology teachers, chose to be biologists. Thus, exercises that enable today's students to understand structure, function and benefits of outdoor world may stimulate their curiosity as well, and help sustain their satisfaction and interest in biology. Merits and impacts of outdoor teaching have also been well-recognized in a variety of scopes such as camping education [3], extension and enrichment of curriculum [4], and experiential [5] and collaborative [6] learning. Furthermore, dedicated outdoor learning is found to increase enthusiasm and attendance, decrease behavioral problems [7,8], and improve cognitive function and academic achievement [9]. However, a large proportion of the U.S. population today has abandoned the natural world mainly due to lack of early experience with nature [10], and the same trend is experienced in the UK [11]. A variety of limitations including lack of teacher preparedness, limited encouragement by schools, differences in curricular priorities and inaccessibility to field sites in and around especially urban universities [12], time, cost of transport, risk [13], etc. underlie this decline in student exposure to the outdoors. Scott, Boyd, Scott and Colquhoun grouped the barriers that prevent outdoor learning into two main categories, teacher confidence and school culture [14]. Future biologists, today's biology undergraduates in particular, need the opportunities to experience outdoor learning that impart curiosity, joy and enrichment of the subject.

At the university level, this decline in teaching and learning field biology and dilemmas associated with it are also well-recognized, particularly with regard to identification of plants and animals, which is fundamental to the appreciation and understanding of natural history and our surroundings [15,16]. It is, however, possible to engage students in an effective outdoor learning experience on our campus premises in the U.S. and elsewhere without travelling long distances to field sites, especially in the study of plant diversity. This article describes how we have accomplished that at Xavier University of Louisiana (XULA) located in the city of New Orleans, LA, USA, and provides examples of strategies and assessments used with the expectation that biology instructors elsewhere will make necessary adjustments to develop similar exercises using suitable botanical stations available on their campuses. XULA is a mainly minority-serving institute with a nationally renowned biology pre-med program [17]. Despite the success of the program, only up to a third of the graduating class enters medical school annually. Given the unacceptably low minority representation in biology Ph.D.s, Doctors of Philosophy, nationally [18], including in organismal biology [19], a large proportion of the minority biology graduates not entering medical school from pre-med programs may also be an opportunity. This outdoor exercise may also help enhance chances of their participation in non-medical biological sciences at the postgraduate level. Objectively planned outdoor exercises can also help integrate biology core concepts with eventual competencies [20,21] while adding value to the everyday classroom experience [22] of students in any undergraduate biology program, minority-serving or other.

Thus, the broad goal of this exercise was to develop a non-medical, no-cost and convenient activity to help fulfill the need for outdoor exposure of undergraduate Biology majors. The specific objectives of the exercise were: (a) to provide students with a hands-on experience and a deeper understanding of how the local botanicals of *Bryophytes*, *Pteridophytes*, *Gymnosperms* and *Angiosperms* contribute to the existence of other life forms in their surroundings in an outdoor setting and (b) to evaluate student-perceived and actual knowledge gain from the exercise by summative assessments. Conduct, assessment and suggestions for implementation of the exercise are discussed.

2. Methods

2.1. Course Content and Accommodations

The Biodiversity course at XULA covers fundamentals of evolution, a survey of eukaryotic kingdoms and principles of ecology taught in sequence. A survey of eukaryotic kingdoms covers cladograms to discuss evolution of major clades and Linnaean taxa with their major characteristics and representatives. Students taking the course are approximately 19-year-old sophomore biology majors. By the time of taking this on-campus tour exercise as part of their lab, students were familiar with the basics of plant systematics such as the cladogram showing four major plant groups (nonvascular *Bryophytes*, vascular seedless *Pteridophytes*, seed non-flowering *Gymnosperms*, and flowering *Angiosperms*), their phyla and few common names of their major representatives. The exercise was introduced following the two Biodiversity labs in which students use a combination of preserved samples, microscopic slides and occasional potted live specimens of the four major plant groups to draw pictures and label structures. Time for the exercise was found by consolidating four other lab periods to follow into three labs which covered animals using preserved specimens in class and a review for the final exam without replacing any content. Biodiversity being the third biology core course in the sequence, fall semester had a higher number of class sections and students per section than spring. This exercise has been conducted continuously for the past 11 years while the data presented in this paper were collected over a period of six years.

2.2. Worksheet and Map

Ten tree species including *Gymnosperms* and *Angiosperms*, and four other botanical groups, namely, parasitic plants, lichens, epiphytes and herbaceous plants, which included *Bryophytes*, *Pteridophytes* and *Angiosperms* in close vicinity on campus, were identified for the exercise. Trees were listed as numbered stations according to the planned sequence of visits to them, and the discussion topics were included in a note-taking column as shown in Table 1 to cover the specific objective (a). The four non-tree botanical groups were numbered following ten trees on the worksheet and were planned to be covered between visits to the trees based on the proximity of the group to a visiting tree station. A Google Earth map with the stations labeled was prepared (Figure 1) to accompany the worksheet. While the sequence of stations to visit during a class tour was determined considering the blockades on the path due mainly to construction activities on campus, the most recent tours started at station 1 and ended at 11. Since botanical groups 12 and 13 were on the tree number 2, all three were covered together while the botanical group 14 was covered between trees, 4 and 5 (Figure 1). In the worksheet, Phylum *Magnoliophyta* meant the most inclusive plant phylum, all flowering plants. Economic benefits discussed included mainly the food for people from different tree species, timber, ornamental or shade value in landscaping, medicinal or other industrial uses, etc. Ecological benefits included air and soil quality improved and sustained by trees; food for animals with examples such as squirrels, other rodents and birds eating seeds, moth and butterfly caterpillars feeding on leaves; shelter for many animal species; trees hosting epiphytes and lichens; poisonous compounds in some trees, etc. Morphological characteristics included appearance of the tree in the winter, its stature and architecture, leaf shapes (e.g., deciduous or evergreen, relative size to which the tree grows, branching patterns of the main trunk and presence of simple/lobed/compound leaves, etc.) and simple flower morphology. In the non-tree botanical groups, nutritional meant nutritional habits of these groups or their components such as fungi and algae in the case of lichens. A quiz used for the assessment of actual knowledge gain was prepared based on the discussion had during the tour, and, therefore, the notes to be written by students in the worksheet. For the purpose of adoption, the design of the worksheet, therefore the map, could be changed, considering the specific course objectives, material already covered, types of trees and other botanical groups present on the given campus premises and the length of the time available for the exercise.

Table 1. Format of the worksheet used by students to take notes during the on-campus tour exercise. Numbers 1–10 = trees; 11–14 = other botanical groups.

Tree/Botanical Group No.	Common Name	Botanical Name	Basic Classification (Major Group, Phylum—Class in *Magnoliophyta*), Ecological and Economic Benefits/Uses, Morphology (Seasonal Appearance, Relative Size and Architecture, Leaf Shapes, Flower Characteristics), Native Land of Trees; Nutritional Habits of Non-Tree Botanicals, etc.
1	Bald cypress	*Taxodium distichum*	
2	Live oak	*Quercus virginiana*	
3	Crape myrtle	*Lagerstroemia indica*	
4	Sweet gum	*Liquidamber styraciflua*	
5	Pear	*Pyrus communis*	
6	Arbor vitae	*Thuja occidentalis*	

Table 1. *Cont.*

Tree/Botanical Group No.	Common Name	Botanical Name	Basic Classification (Major Group, Phylum—Class in *Magnoliophyta*), Ecological and Economic Benefits/Uses, Morphology (Seasonal Appearance, Relative Size and Architecture, Leaf Shapes, Flower Characteristics), Native Land of Trees; Nutritional Habits of Non-Tree Botanicals, etc.
7	Sago palm	*Cycas revoluta*	
8	Callery pear	*Pyrus calleryana*	
9	Pine	*Pinus spp.*	
10	Oleander	*Narium oleander*	
11	Parasitic Dodder plant	*Cuscuta sp.*	
12	Lichens		
13	Epiphytes (e.g., resurrection fern, mosses, Spanish moss)		
14	Herbaceous plants (e.g., clover, dandelion, broadleaved plantain, common purslane, spotted spurge, nutsedge, grasses)		

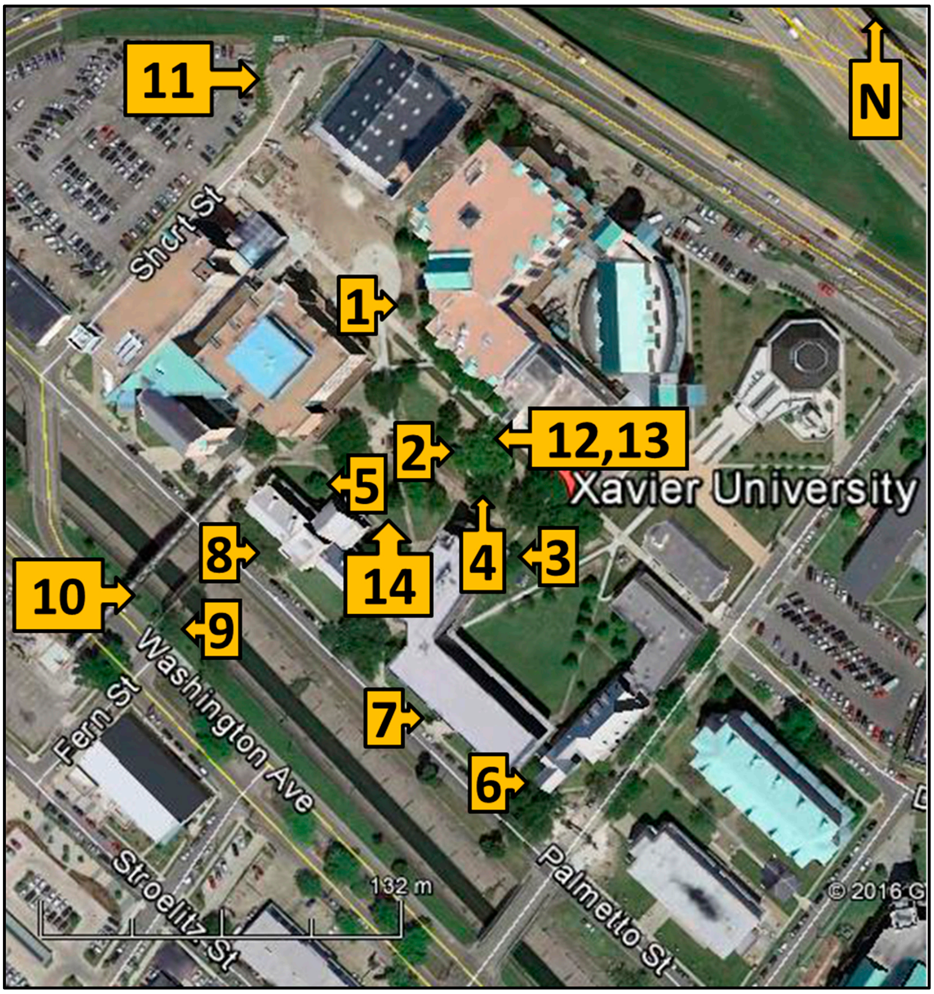

Figure 1. Google Earth map of the locations of trees (1 through 10) and other botanical groups (11 through 14) used for the exercise. Numbers of trees and other botanical groups are the same as in the worksheet.

2.3. Botanical Tour

A mock tour was taken first to approximately estimate and adjust the time needed to walk to each station, complete the discussion of the station, and take notes (Table 1). The tour was restricted to the coverage mentioned in the worksheet considering that the total time allocated for the lab was 1 h and 50 min, and students (a) would spend ~20 min in class for taking a short quiz from the previous lab and listening to a directive to the conduct of the exercise; (b) would take approximately another 20 min for walking between stations shown in Figure 1; and (c) would be dismissed ~10 min before the end of the lab period allowing them to go to their next class from the last station of the exercise. During the in-class directive, use of both worksheet and the map were briefed on. Students were asked to use the map during the tour and again later if they wanted to re-visit any station and review the materials discussed during the tour. They were reminded to stay together as one group and bring the worksheet and something to keep under it as support while writing but not the book bags. Both during the in-class directive and while on the tour, students were encouraged to observe, touch, take pictures and ask questions about the trees and other botanical groups that they would visit on tour. Photographs presented (Figure 2) were taken by students.

(a) (b)

Figure 2. Students writing notes for Live Oak tree (*Quercus virginiana*) (**a**). Observations and discussions on moth eggs on oak leaves; seeds used as food by rodents; epiphytic lichens, mosses, resurrection fern and Spanish moss on the bark allowed students to appreciate multiple ecological benefits of the tree. A student writing notes using a flower picked from the pear tree (*Pirus communis*) and checking if it is *Monocot* or *Eudicot* (**b**).

2.4. Qualitative Assessment

Two summative student surveys were conducted over a period of six years (Table 2). Survey 1 was administered to each student pre- and post-exercise in six class sections in fall and three sections in spring to determine student-perceived improvement in 10 knowledge areas covered by the exercise. Data collected from the second survey (Table 2) conducted in eight fall and three spring sections served as student feedback on the conduct of the exercise. Rankings of survey 1 data were used to calculate the percentage student-perceived improvement as, ((post-exercise rating —pre-exercise rating)/pre-exercise rating) × 100. Survey 2 responses were processed using the pivot table feature on Microsoft Excel 2010.

Table 2. Two surveys administered to assess the student-perceived improvement in specific knowledge areas (survey 1, administered pre- and post-exercise) and the conduct of the exercise (survey 2).

Survey 1. Circle One Number as the Answer for Each Question.		**Name**				
Question		Response (1 = not knowledgeable; 5 = very knowledgeable)				
1	How knowledgeable are you of the four major plant groups?	1	2	3	4	5
2	How knowledgeable/familiar are you of the trees in local parks, campuses or other man-made landscapes?	1	2	3	4	5
3	How knowledgeable are you of the ecological benefits/contributions of the local trees?	1	2	3	4	5
4	How knowledgeable are you of the economic benefits/uses of the local trees?	1	2	3	4	5
5	Are you aware of the state trees of your and neighboring states?	1	2	3	4	5
6	Do you know the different leaf forms (morphologies) of local trees?	1	2	3	4	5
7	Are you familiar/knowledgeable with the major *Gymnosperms* in and around campus?	1	2	3	4	5
8	Are you knowledgeable of the representatives of *Monocots* and *Eudicots* in the local landscape?	1	2	3	4	5
9	Are you knowledgeable of the visible symbiotic relationships that local plants harbor?	1	2	3	4	5
10	Are you knowledgeable of the non-woody (herbaceous) plants in the local landscape?	1	2	3	4	5
Survey 2 Please Answer the Following Questions Regarding the on-Campus Tour Last Week.						
1	Given the time allocated to the lab, was the coverage of subject material (e.g., number of items on the handout) adequate? (please also comment, if desired).					
2	Was the time used effectively? (please also comment if desired).					
3	Did the exercise help strengthen your knowledge/experience of the plant kingdom? Please circle one, A. Yes, a great deal B. Yes, to some extent C. Yes, only marginally D. No and reason out your above answer with examples, if possible, below.					
4	Based on the overall exercise (educationally, logistically or in any other aspect), please indicate what worked well.					
5	Based on the overall exercise (educationally, logistically or in any other aspect), please indicate what did not work well? Please suggest improvements, if possible?					

2.5. *Quantitative Assessment*

Student grades from a ten question post-exercise quiz were compared with the averaged grades of two quizzes from other plant-related labs conducted in-class previously to determine the actual knowledge gain in eight fall and three spring sections. Each quiz had the same format with 10 multiple choice questions each with equal points. Since both quiz types were administered to the same individual students the mean comparison for quiz grades was performed with "repeated measure" under "general linear model" using SPSS V. 19.0.0.1 [23,24].

3. Results

3.1. *Student-Perceived Knowledge Improvement*

Students reported that their knowledge improved in all 10 areas investigated. The lowest improvement, 66%, was reported for the knowledge of four major plant groups while the highest, 200%, for the knowledge of major local *Gymnosperms* (Figure 3). Four knowledge areas, namely: (a) four major plant groups; (b) trees in local campuses and parks; (c) ecological benefits and (d) economic benefits of trees had lower (111%) self-reported improvement, averaged across the two semesters, than the other six knowledge areas. These six areas included: (a) state trees of neighboring states; (b) leaf morphologies; (c) local *Gymnosperms*; (d) local *Angiosperms* (*Monocots* and *Eudicots*); (e) symbiotic relationships of plants with other organisms; and (f) herbaceous plants, which showed 187% improvement. Students' self-reported improvement in each knowledge area showed no difference between semesters.

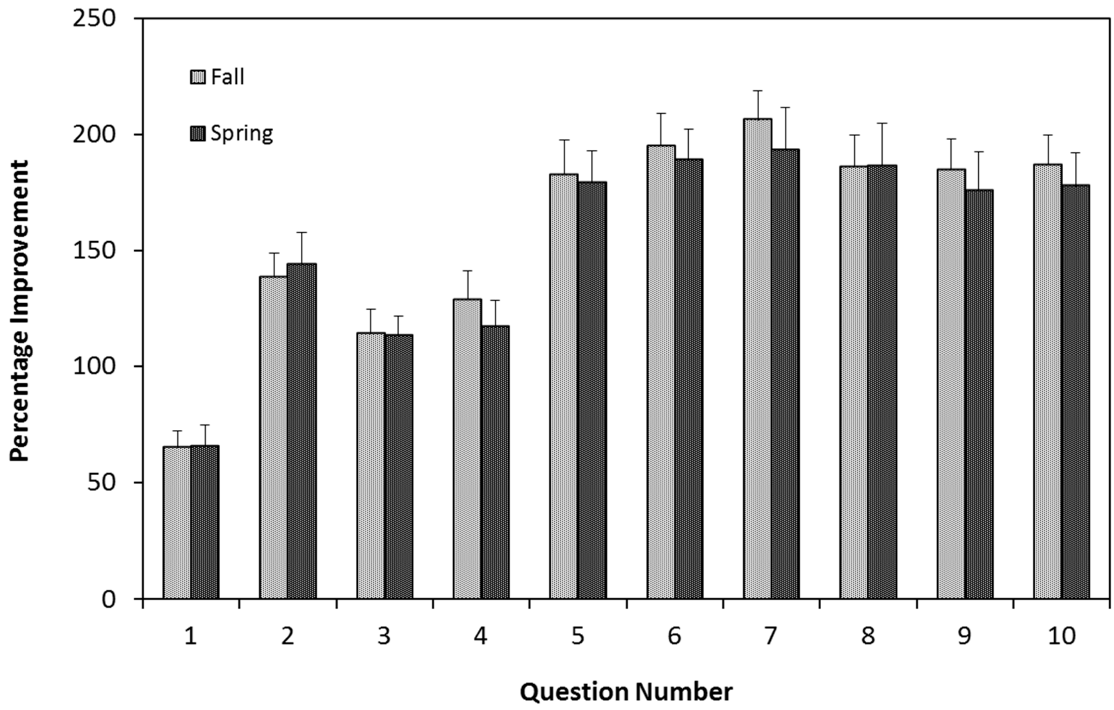

Figure 3. Improvement of student-perceived knowledge in ten subject areas questioned in survey 1. $N = 95$ and 44 for fall and spring, respectively. Error bars are SE.

3.2. Conduct

Student engagement was evident by consistently observing, touching and picking parts of specimens visited; frequent commenting on what they saw; questioning and note taking etc. (Figure 2). In survey 2, each student reported that the content covered was adequate and time was used efficiently (Table 3). Largest proportion of students, ≥50%, in each semester, responded "a great deal" while none responded "no" to the question, "Did the exercise help strengthen knowledge/experience of the plant kingdom?". Moreover, every student had responses to the question, "What worked?". Most students identified visual, hands-on and experiential learning as the reason why the exercise strengthened their knowledge of the plant kingdom followed by the information learned about each tree or botanical group. Organization of the tour and the coverage of material were cited most frequently as "what worked" followed by studying or being outdoors. In each semester, at least 50% of the students had no responses to the question, "What didn't work—suggest improvements" (Table 3). Students who responded to this question most frequently cited worksheet-related concerns. More than 50% of the worksheet-related concerns were about "too much information to write" followed by "an item was missing" and "sequence was not followed exactly". The most frequent comment under the season/weather-related concerns was "flowers (or leaves) were not there" followed by "weather too hot".

3.3. Actual Knowledge Gain

Performance on the quiz from the on-campus tour was 11.2 and 18.5% greater ($p < 0.001$), resulting in 0.82 and 1.16 points higher grade out of 10, compared to the average performance on the other two plant-related quizzes from the labs conducted in-class in fall and spring, respectively (Figure 4, descriptive statistics in Table 4 and results of the mean comparison in Table 5). Although the quiz grade from the on-campus tour was 9.5% higher in fall than spring ($p < 0.01$), improvement in the grade by on-campus tour was the same in each semester ($p = 0.14$).

Table 3. Percentage student responses for different categories covered in survey 2. N = 154 and 44 for fall and spring, respectively.

Semester	Coverage Adequate?		Time Used Effectively?		Strengthened Knowledge or Experience of the Plant Kingdom?				What Helped Strengthen Knowledge or Experience?				What Worked During the Tour?		What Didn't Work? Suggest Improvements to the Tour.						
	Y	N	Y	N	YG	YS	YM	N	VH	IT	KL	NA	TO	SO	WS	CW	SD	SW	DH	TW	NA
Fall	100	0	100	0	50	42	8	0	61	30	4	5	51	49	28	6	0.06	4	7	3	51
Spring	100	0	100	0	53	47	0	0	64	36	0	0	75	25	17	0	7	15	11	0	50

Y—Yes; N—No; YG—Yes a great deal; YS—Yes to some extent; YM—Yes marginally; VH—Visual/hands-on experience; IT—Information on each tree/botanical group; KL—Knowledge on local landscape; NA—Not available; TO—Tour organization/coverage; SO—Studying/being outdoor; WS—Worksheet-related; CW—Construction work on campus; SD—Student distractions; SW—Season/weather-related; DH—Difficulty hearing; TW—Tiring/boring walk.

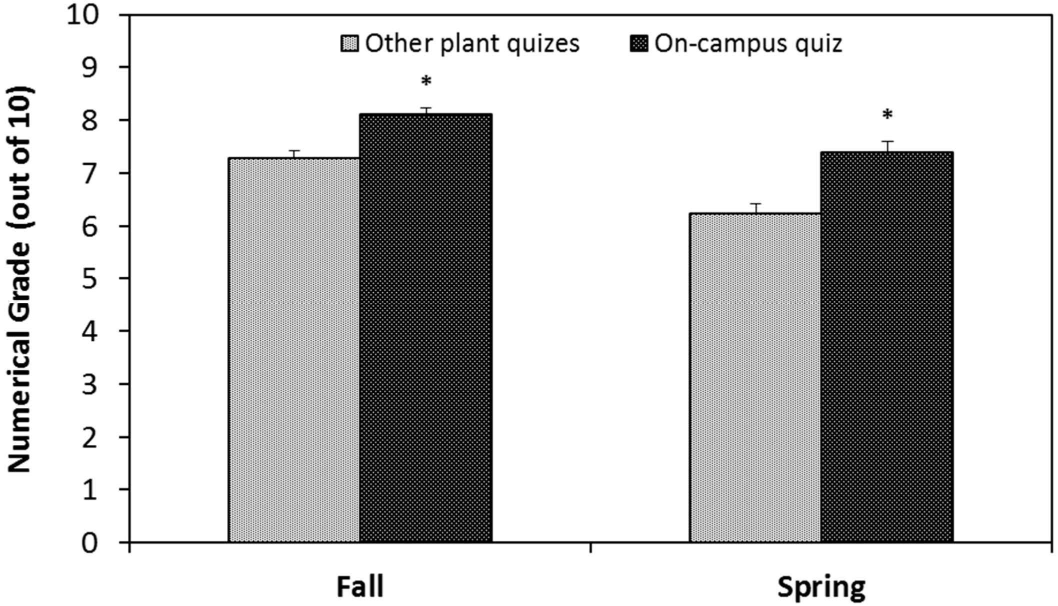

Figure 4. Student performance on the quiz from the on-campus tour exercise compared to the average performance on the two other quizzes from plant-related labs conducted in the classroom. The asterisk above a bar indicates statistical significance compared with the other value in a semester ($p < 0.001$). N = 164 and 70 for fall and spring, respectively. Error bars are SE.

Table 4. Descriptive statistics for the quiz comparison shown in Figure 4.

Semester/Descriptive Statistic	Fall		Spring	
	On-Campus Quiz	Other Plant Quizes	On-Campus Quiz	Other Plant Quizes
Mean	8.11	7.30	7.40	6.24
Median	8.25	7.50	8.00	6.25
Mode	10.00	7.50	9.00	6.00
Standard Error	0.13	0.14	0.22	0.19
Kurtosis	0.21	−0.57	−0.10	0.14
Maximum	10.00	10.00	10.00	9.00
Minimum	3.00	2.50	3.00	2.00
Range	7.00	7.50	7.00	7.00
Sample Variance	2.88	3.07	3.29	2.65
Skewness	−0.85	−0.43	−0.62	−0.61
Standard Deviation	1.70	1.75	1.81	1.63
Count	164	164	70	70

Table 5. Results of the general linear model used for the quiz comparison shown in Figure 4.

Semester	Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance
Fall	Intercept	19,472.54	1	19,472.54	4079.76	0.000
	Error	777.99	163	4.77		
Spring	Intercept	6514.46	1	6514.46	1445.16	0.000
	Error	311.04	69	4.51		

3.4. Discussion and Educational Implications

Assessment showed that the exercise enhanced both student-perceived knowledge and actual knowledge gain. Student-perceived improvement of knowledge, while not an effective measure of knowledge gain [25], is indicative of student satisfaction, which is a predictor of quality of learning outcome [26]. Interestingly, students felt that the on-campus tour exercise strengthened their knowledge substantially (111% improvement) even in the subject areas that had already been covered in previous indoor labs and lecture, such as the subjects addressed in the first four questions of survey 1. Unsurprisingly, students reckoned that the exercise more markedly strengthened (187% improvement) their knowledge of the subjects that they were not directly taught prior to the exercise, the subjects addressed in questions five through ten of survey 1. Thus, this outdoor exercise shows promise for increasing student satisfaction in both reviewed and newly introduced subject areas. Student satisfaction and engagement were also evidenced by the results presented under conduct. For instance, every student had favorable comments about either outdoor experiential learning or tour organization/coverage under "what helped strengthen knowledge/experience" and "what worked", while the largest proportion of students had no response to "what didn't work, suggest improvements" even when asked to "suggest improvements". Furthermore, frequent questioning, sharing ideas freely among peers, following directions including note-taking and staying together as one group observed during the tour testified to the relaxed engagement of students in the exercise. Increased note-taking and verifying with me if the notes were correct, and more frequent group discussion among students compared to in-class labs was also evident. Students themselves identified "opportunities for group discussion" as part of "what worked" in survey 2. Research shows that learning in a group setting transforms the learning experience from competitive to collaborative, makes students engaged who otherwise might not become actively engaged [27], and improves grades in STEM fields [28]. In this exercise, students' awareness that the information covered during the tour was not available from the lab manual or textbook may also have contributed to their deeper engagement. Thus, one main outcome of the exercise was the student satisfaction, which translated into their engagement with what they handled eventually instigating effective experiential learning. Dedicated exposure to the local outdoors also encourages students to map their bioregion and understand the ecological and socioeconomic benefits of the world [29]. Students' experiences that (a) initiate interest in biology-at-work outdoors; (b) motivate them to ask questions and (c) engage them with the material they work with, may also strengthen their will to seek undergraduate research opportunities, which is the turning point for many to pursue careers in research [30,31]. Subsequently, a career in research is perceived by most students to be associated with high job satisfaction and social status [32].

Knowledge gain shown by higher quiz grades from the on-campus tour exercise compared to the two in-class labs that mainly used preserved specimens may result from the increased understanding and remembrance of the material learned as a result of hands-on, experiential and engaged learning that happened with a greater satisfaction during the on-campus tour. With the exception of basic taxonomy, much of the material covered during the on-campus tour exercise was not covered in previous plant labs or the lecture. For instance, ecological and economic uses, state trees of adjacent states, herbaceous plants, leaf morphologies, poisonous trees, native lands, botanical names, etc. learned during the on-campus tour as opposed to the overall cladogram, names of taxa and the common names of few representatives of those taxa learned in the previous labs or lecture. Moreover, the quiz from the on-campus tour did not include any question directly related to the previously covered materials. Therefore, the higher quiz grade from the on-campus tour exercise is most likely due to the attributes of outdoor experiential learning rather than due to the knowledge from materials covered already. The Biodiversity course in the fall semester is comprised mostly of students directly progressing from previous biology core courses, General Biology 1 and 2 (regular sequence) compared to the spring, which tends to enroll a sizeable number of students repeating the course or transferring from a different program (off sequence). Interestingly, although this difference between the two cohorts was manifested as a greater quiz grade in fall than spring, the on-campus tour exercise imparted the same degree of improvement in knowledge gain in either cohort.

Assessments by the surveys and the quiz testified that the students acknowledged and experienced the influence of the exercise on their learning of multiple areas of the main subject, the study of plants in Biodiversity. For instance, discussion on social recognition of trees by way of naming state trees, experiencing the fundamental biological principles such as symbiosis, becoming aware of local representatives of major plant groups, knowing that herbaceous plants are immediately important as most of the human food, being able to recognize trees by names using morphological characteristics, etc. were either reported as knowledge/skill areas that were highly improved or commented as reasons why the exercise was interesting. Thus, the findings of this study show that given the proper exposure and guide, students can be motivated to appreciate outdoor experience, a core meaning of biology. Such planned guidance is increasingly significant today due to (a) poor representation of organismal diversity in current biology curricula [33]; (b) inadequate basic systematics skills of biology students [15,16]; (c) student perception that biology curricula are detached from their lives and interests [34] and (d) general public perception that modern biology students are distracted from the nature. The opportunity for students to apply what they learn in class to the local outdoor environment, and to work interactively as a team may also help them develop improved study habits.

4. Conclusions

Assessment of this on-campus tour exercise showed that it (a) instigated student satisfaction and engagement in learning plant-related biodiversity of the local environment; and (b) enhanced the knowledge of selected subject areas of the curriculum that can be connected to outdoors. Findings testified that, given the opportunity, students willingly engage in and apply what they experience in the outdoor world contrary to the general perception that today's biology students are inadequately interested in the outdoor environment. Teaching outdoors was useful for both review and introduction of new material notwithstanding the inherent differences in academic performance of student cohorts of different semesters. Thus, an on-campus tour exercise is both an academically effective and a practically convenient alternative when organized field trips with the class are not possible.

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References

1. Elliott, K.M.; Shin, D. Student satisfaction: An alternative approach to assessing this important concept. *J. High. Educ. Policy Manag.* **2002**, *24*, 197–209. [CrossRef]
2. Pintrich, P.R.; Schunk, D.H. *Motivation in Education: Theory, Research and Applications*, 2nd ed.; Merrill: Upper Saddle River, NJ, USA, 2002.
3. Sharp, L.B. Outside the classroom. *Educ. Forum.* **1943**, *7*, 361–368. [CrossRef]
4. Hammerman, W.M. *Fifty Years of Resident Outdoor Education, 1930–1980: Its Impact on American Education*; American Camping Association: Martinsville, IN, USA, 1980.
5. Hammerman, D.R.; Hammerman, W.M.; Hammerman, E.L. *Teaching in the Outdoors*, 5th ed.; Interstate Publishers: Danville, IL, USA, 2001.
6. Boes, K.E. Campus Eco Tours—An integrative & interactive field project for undergraduate biology students. *Am. Biol. Teach.* **2013**, *75*, 330–334.
7. Lieberman, G.A.; Hoody, L. *Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*; California Student Assessment Project: Poway, CA, USA, 1998.
8. Barrows, R.M.; Silver, E.J.; Stein, R.E. School recess and group classroom behavior. *Pediatrics* **2009**, *123*, 431–436. [CrossRef] [PubMed]
9. Fägerstam, E.; Blom, J. Learning biology and mathematics outdoors: Effects and attitudes in a Swedish high school context. *J. Advent. Educ. Outdoor Learn.* **2013**, *13*, 56–75. [CrossRef]
10. Weigl, P.D. The natural history conundrum revisited: Mammalogy begins at home. *J. Mamm.* **2009**, *90*, 265–269. [CrossRef]
11. Barker, S.; Slingsby, D.; Tilling, S. *Teaching Biology Outside of the Classroom: Is It Heading for Extinction? A Report on Biology in the 14–19 Curriculum*; Field Studies Council Occasional Publication 72; Preston Montford: Shropshire, UK, 2002.
12. Zettler, J.A.; Collier, A.; Leidersdorf, B.; Sanou, M.P. Plants in your ants; using ant mounds to test basic ecological principles. *Am. Biol. Teach.* **2010**, *72*, 173–176. [CrossRef]
13. Lock, R. Biology fieldwork in schools and colleges in the UK: An analysis of empirical research from 1963 to 2009. *J. Biol. Edu.* **2010**, *44*, 58–64. [CrossRef]
14. Scott, G.W.; Boyd, M.; Scott, L.; Colquhoun, D. Barriers to biological fieldwork: What really prevents teaching out of doors? *J. Biol. Edu.* **2015**, *49*, 165–178. [CrossRef]
15. Scott, G.W.; Goulder, R. Conflicting perceptions of the status of field biology and identification skills in UK education. *J. Biol. Edu.* **2016**, *50*, 233–238.
16. Bilton, D.T. What is in a name? What have taxonomy and systematics ever done for us? *J. Biol. Edu.* **2014**, *48*, 116–118. [CrossRef]
17. Hannah-Jones, N. *A prescription for More Black Doctors*; New York Times: New York, NY, USA, 2015.
18. Rath, K.A.; Peterfreuand, A.R.; Xenos, S.P.; Bayliss, F.; Carnal, N. Supplemental instruction in introductory biology I: Enhancing the performance and retention of underrepresented minority students. *CBE-Life Sci. Edu.* **2007**, *6*, 203–216. [CrossRef] [PubMed]
19. Baker, B. Recruiting minorities to the biological sciences: Biologists are trying a range of approaches to diversify their field. *Bioscience* **2000**, *50*, 191–195. [CrossRef]
20. Ksiksi, T.S. Teaching introductory Biology courses: What works and what does not work. *Am. Eurasian J. Sci. Res.* **2006**, *1*, 46–48.
21. American Association for the Advancement of Science. *Vision and Change in Biology Education, a Call to Action*; American Association for the Advancement of Science: Washington, DC, USA, 2011.
22. Dillon, J.; Rickinson, M.; Teamey, K.; Morris, M.; Choi, M.Y.; Sanders, D.; Benefield, P. The value of outdoor learning: Evidence from research in the UK and elsewhere. *School Sci. Rev.* **2006**, *87*, 107–111.
23. International Business Machines. *SPSS version 19.0.0.1 Statistical Program*; IBM Co.: Armonk, NY, USA, 2010.
24. Sokal, R.R.; Rohlf, F.J. *Biometry, the Principles and Practice of Statistics in Biological Research*, 3rd ed.; W.H. Freeman and Co.: New York, NY, USA, 1997.
25. Bacon, D.R. Reporting actual and perceived student learning in education research. *J. Market. Edu.* **2016**, *38*, 3–6. [CrossRef]

26. Eom, S.B.; Wen, H.J.; Ashill, N. The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation. *Decision Sci. J. Innov. Edu.* **2006**, *4*, 215–235. [CrossRef]
27. Tanner, K.; Chatman, L.S.; Allen, D. Approaches to cell biology teaching: Cooperative learning in the science classroom—Beyond students working in groups. *Cell Biol. Educ.* **2003**, *2*, 1–5. [CrossRef] [PubMed]
28. Freeman, S.; Eddya, S.L.; McDonougha, M.; Smithb, M.K.; Okoroafora, N.; Jordta, H.; Wenderotha, M.P. Active learning increases student performance in science, engineering, and mathematics. *PNAS* **2014**, *111*, 8410–8415. [CrossRef] [PubMed]
29. Oberbillig, D.; Randle, D.C.; Middendorf, G.; Lardelús, C.L. Outdoor learning in formal ecological education: Looking to the future. *Front. Ecol. Environ.* **2014**, *12*, 419–420. [CrossRef]
30. Gavin, R. The Role of Research at Undergraduate Institutions: Why is it necessary to defend it? In *Academic Excellence. The Role of Research in the Physical Sciences at Undergraduate Institutions*; Doyle, M.P., Ed.; Research Corporation: Tucson, AZ, USA, 2000; pp. 9–16.
31. National Research Council (U.S.) Committee on Undergraduate Biology Education to Prepare Research Scientists for the 21st Century. In *Bio2010: Transforming Undergraduate Education for Future Research Biologists*; National Academies Press: Washington, DC, USA, 2003.
32. Henderson, D.; Stanisstreet, M.; Boyes, E. Who wants a job in biology? Student aspirations and perceptions. *J. Biol. Edu.* **2007**, *41*, 156–161. [CrossRef]
33. Greene, H.W. Organisms in nature as a central focus for biology. *Trends Ecol. Evol.* **2004**, *20*, 23–27. [CrossRef] [PubMed]
34. Hagay, G.; Baram-Tsabari, A. A shadow curriculum: Incorporating students' interests into the formal biology curriculum. *Res. Sci. Edu.* **2011**, *41*, 611–634. [CrossRef]