Teaching Methods

Integrating Hoop House Construction and Environmental Data Interpretation into an Undergraduate General Education Plant Science Course

Mark E. Uchanski[1,3], Kulbhushan Grover[1], Dawn VanLeeuwen[2], and Ryan Goss[1]

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SUMMARY. **Experiential learning can be used as part of the undergraduate curriculum to provide real-world experience in the classroom. A hands-on hoop house construction project was integrated into an undergraduate general education plant science course at New Mexico State University in Las Cruces. The objectives were to provide students with hands-on experience in hoop house construction and data collection and interpretation, evaluate students' perception about the educational value of the hoop house construction activity and delivery methods, and evaluate individual student's perceptions about their participation in the group activity and group dynamics. Eighty-four students were enrolled in Spring 2013 semester. Students were surveyed in a follow-up laboratory 10 weeks after the hoop house construction activity for data collection and reflection. The survey tool assessed the impacts of class materials, laboratory materials, and the laboratory teaching assistants (TAs) on the students' learning experience: perceptions of group work, their role within their groups, and their participation. Ninety percent and 95% of the students agreed or strongly agreed knowledge of basic techniques and practical application of hoop house construction, respectively, were obtained in the exercise. Eighty-five percent of student respondents indicated a gain in their appreciation for scientific data collection and interpretation through this exercise. Also, a majority (65%) of the students agreed this hands-on task improved their appreciation for group activities indicating experiential learning group work during scheduled class time could be a useful tool for team building and other learning experiences. Finally, more than 90% of the students found this activity overall beneficial. We conclude that integrating hoop house construction and data collection into an undergraduate general education plant science course can be an effective way to enhance student learning.**

Real-world science applications such as experiential learning, case studies, internships, externships, field trips, and practitioner interviews are used frequently to enhance student problem-solving skills in the classroom (Kolb, 1984). Experiential learning can also help students interact with the course material (Keeton and Tate, 1978) and can be used as part of the undergraduate curriculum to provide students hands-on, real-world experience in the classroom. Experiential learning fosters higher retention of knowledge as compared with lecture-style teaching (Specht and Sandlin, 1991; Van Eynde and Spencer, 1988). Several studies have demonstrated that experiential learning improved learning and enhanced skills (Eyler, 2009; Paul and Mukhopadhyay, 2005). Learning through hands-on activities is important for horticulture and other applied disciplines, particularly while teaching a relatively new technology or management practice (Grover and Stovall, 2013). Montgomery and Millenbah (2011) also found that students in outdoor settings learn better than those in indoor settings.

High tunnels, hereafter referred to as hoop houses, are temporary plastic-covered structures used to extend the growing season by keeping the temperatures relatively warm during the winter (St. Hilaire et al., 2009; Walker et al., 2012). These structures typically do not have supplemental heating or cooling, and are particularly popular among small producers and homeowners because they can provide opportunities to boost income and sustainability through additional production during winter. However, planning and management of production in hoop houses requires problem-solving and analytical skills. For example, producers must evaluate the type of hoop house covering to be used to maximize yield and the related physiological impacts on plant growth. Learning hoop house production techniques, therefore, also requires higher levels of critical thinking and analytical information processing (Millenbah and Millspaugh, 2003).

St. Hilaire et al. (2009) described the benefits of involving students in the construction and operation of hoop houses to provide experiential learning and practical agricultural skills to plant science majors and non–plant science majors alike. We add to this educational research by including students' assessment of group work and their own participation in the activity. An agricultural science research project was designed to assess the impacts of hoop house glazing on environmental factors such as photosynthetically active radiation (*PAR*) and internal/external temperatures. This study involved an evaluation of the educational value of hoop house construction through self-assessment by the student participants. This exercise provided students with hands-on experience in hoop house construction and data interpretation. The objectives of the study were to evaluate students' perceptions of the value for measuring environmental conditions important for hoop house production, students' perceptions on the educational value of the exercise and method of class content delivery, and students' perceptions of their participation in the group activity and group dynamics.

Materials and methods

Introductory Plant Science (HORT/AGRO 100G) is a general education course offered every semester by the Department of Plant and Environmental Sciences at New Mexico State University (NMSU). The course earns four credit hours and the lecture meets for 50 min 3 d per week. For laboratory purposes, the class is divided into five sections that meet for 2 h per week, and are taught by TAs. Each laboratory section had 7–18 students enrolled. Horticulture or agronomy majors comprise a minority (<10%) of the overall enrollment because the course is open to any student on campus to fulfill their laboratory sciences requirement at NMSU. As a result, enrollment has grown in recent years from ≈50 in Fall 2006 to nearly 120 in Fall 2012. Eighty-four students were enrolled in Spring 2013 and 63 (75%) returned valid responses to our survey tool, likely due to absence(s) or opting out of participation. Only 39% of the enrolled students were majoring in agriculture-related disciplines in the College of Agricultural, Consumer, and Environmental Sciences, with 30% majoring in the College of Arts and Sciences and 17% majoring in Business. The majority of students enrolled in the class were freshmen (36%) or sophomores (29%), while a relatively small fraction of the students were in their junior (17%) or senior (11%) years.

Simple, low-cost hoop houses (4 × 5 m) have been used to demonstrate season extension in other Introductory Plant Science laboratory activities at NMSU, but students have not been involved in the actual construction for several years. Each of the five laboratory groups constructed a hoop house from start to finish during the 2-h class time for a total of five structures. The hoop house series of laboratory activities consisted of at least three class meetings: one at the start of the semester to build the hoop house structures; a second to plant, fertilize, and maintain vegetable plots; and a third to harvest vegetables, analyze data, and take the survey tool. This third laboratory meeting occurred 10 weeks after the original hoop house construction activity to allow for data collection and reflection.

Fig. 1. Students and teaching assistants apply opaque polyethylene as glazing on one of five 12 × 15-ft (3.7 × 4.6 m) hoop houses as part of the laboratory sections of the Introductory Plant Science (HORT/AGRO 100G) class at New Mexico State University at Las Cruces in Spring 2013. Clear polyethylene can be seen on the hoop house to the left.

The hoop houses used in this project were adapted from Jimenez et al. (2005), and were oriented with the long side running north to south based on magnetic north. The frame of the tunnel was built from bent 1-inch diameter by 20-ft polyvinylchloride (PVC) pipe or two joined 1-inch diameter by 10-ft PVC pipes. Two different glazing materials were employed on two and three houses, respectively: a transparent polyethylene film (6-mil thickness) treated with an ultraviolet light inhibitor treatment (92% transmission; FarmTek, Dyersville, IA) and an opaque polyethylene film (≈6-mil thickness) treated with an ultraviolet light inhibitor (55% transmission; FarmTek) (Fig. 1). All other construction details followed St. Hilaire et al. (2009). Laboratory and classroom activity materials, including construction notes and price sheets, were provided to students 1 week before the laboratory activity with instructions to read them before attending their laboratory section.

One data logger (HOBO U12–008; Onset Computer Corp., Bourne, MA) was mounted to a wooden stake inside each hoop house during planting.

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[1]Department of Plant and Environmental Sciences, New Mexico State University, Las Cruces, NM 88003

[2]Department of Economics, Applied Statistics, and International Business/Agricultural Biometric Service, New Mexico State University, Las Cruces, NM 88003

[3]Corresponding author. E-mail: uchanski@nmsu.edu.

Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.3048	ft	m	3.2808
2.54	inch(es)	cm	0.3937
0.0254	mil	mm	39.3701
(°F – 32) ÷ 1.8	°F	°C	(°C × 1.8) + 32

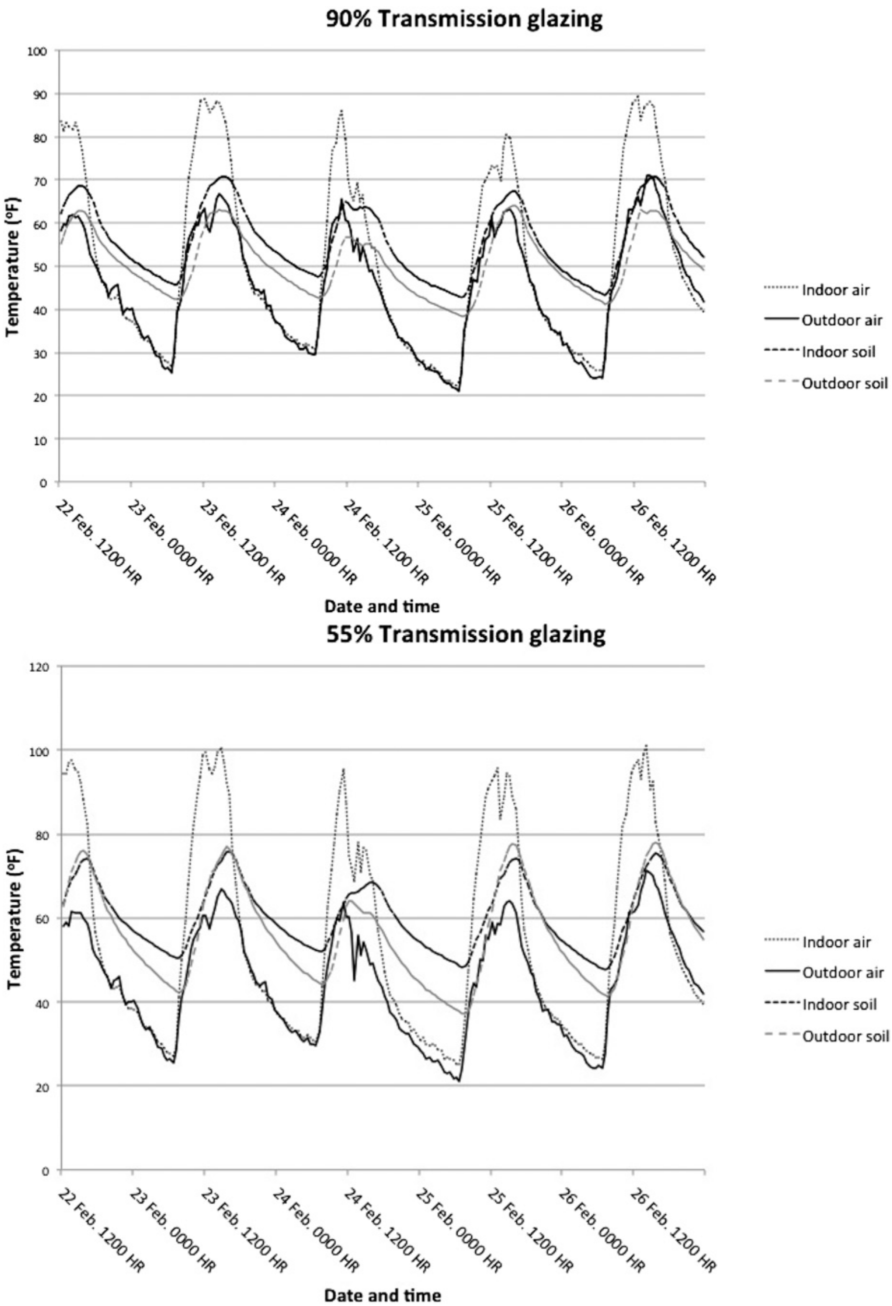

Fig. 2. Indoor/outdoor and soil/air temperatures from hoop houses with two different glazing materials [clear (90% transmission) and opaque white (55% transmission)] during a 5-d time period in late Feb. 2013. These graphs were presented to students at week 10 to initiate discussion on the impact of glazing materials on the environmental conditions and plant growth in each hoop house; 0000 HR = midnight; 1200 HR = noon; (°F − 32) ÷ 1.8 = °C.

Loggers were programmed to record temperature every 30 min, 24 h/d from mid-February until late April. Data logger probes (air/water/soil temperature sensor, 2-m cable, TMC6-HD; Onset Computer Corp.) were placed in four locations in and around each hoop house: indoor air, outdoor (ambient) air, indoor soil, and outdoor soil. Temperature probes were buried 3 inches below the soil surface to record soil temperatures at the crop's [lettuce (*Lactuca sativa*)] root zone, and were also placed 1 ft above the soil surface to record air temperatures. Soil temperature probes were buried horizontally both inside and outside the hoop house. All air temperature sensors were inserted vertically into a solar radiation shield (RS3 solar radiation shield; Onset Computer Corp.) mounted to a wooden stake. Data were downloaded from the loggers near the conclusion of the semester using HOBOware Pro software (version 2.7.3.1; Onset Computer Corp.). Temperature data were graphed and presented to the students during the final laboratory meeting (Fig. 2).

Photosynthetically active radiation was measured with a *PAR* sensor (LP-80 AccuPAR *PAR*/leaf area index ceptometer; Decagon Devices, Pullman, WA) in late April to compare glazing material impacts and transmission in the hoop houses as well as a comparison with an adjacent lath house (visible in Fig. 1). Recorded *PAR* data were collected by TAs and presented during the final class meeting.

The survey tool (Table 1) was designed to repeat several key questions from St. Hilaire et al. (2009), with additional items addressing student perceptions of group work, their role within their groups, and participation [survey items 10–15 (Table 1)]. Students were also asked to assess the importance of environmental data collection such as *PAR* and temperature [survey items 7–9 (Table 1)]. Finally, participants were asked to evaluate the role of the class materials, laboratory materials, and the laboratory TAs in their learning experience [survey items 1–4 (Table 1)]. Internal review board (IRB) approval was obtained from the NMSU Research Compliance Office before administration of the survey tool.

Before statistical analysis, missing values were removed from the analysis resulting in individual items having sample sizes ranging from n = 61–63 for the Likert-scale items. For Likert-scale items, both the percent response distribution, and means and standard deviations with responses coded as 5 = strongly agree, 4 = agree, 3 = undecided, 2 = disagree, and 1 = strongly disagree = 1 were reported. Because the variables were measured on ordinal, not internal or ratio, scales, alternatives to standard tools were used: The Kruskal–Wallis test was used in place of a one-way analysis of variance (ANOVA), the Wilcoxon signed-ranks test was used in place of the paired *t* test, and Kendall's tau-b was used in place of Pearson's coefficient.

Preliminary exploration of whether responses to items differed among laboratory sections was conducted using the

Table 1. Survey tool results from students enrolled in an Introductory Plant Science (HORT/AGRO 100G) laboratory course (n = 63) in Spring 2013. Students were surveyed after completion of a hands-on hoop house construction activity in their laboratory sections.

	Question	Yes (%)	No (%)	No response (%)
Non-Likert	I have built a hoop house before taking this class.	9.3	52.9	37.8

Item no.	Question	SA (%)[z]	A (%)	U (%)	D (%)	SD (%)	Mean (1–5 scale)[y]	SD (1–5 scale)[x]
1	Classroom material supported my learning of hoop house construction.	39.7	42.9	9.5	6.3	1.6	4.1	0.94
2	Laboratory material supported my learning of hoop house construction.	36.5	46.0	9.5	6.3	1.6	4.1	0.93
3	I read the assigned material before the laboratory	28.6	33.3	12.7	15.9	9.5	3.6	1.32
4	Laboratory instructor(s) supported my learning of hoop house construction.	42.9	46.0	6.3	1.6	3.2	4.2	0.89
5	I know the basic techniques involved in constructing a hoop house.	41.3	49.2	3.2	3.2	3.2	4.2	0.91
6	I understand the practical application of building a hoop house.	44.4	50.8	0.0	1.6	3.2	4.3	0.84
7	Instruments that measure environmental conditions are important for hoop house.	47.6	38.1	12.7	0.0	1.6	4.3	0.82
8	I understand that different hoop house covering materials (plastics) can modify the crop environment.	55.6	31.7	6.3	4.8	1.6	4.4	0.92
9	I understand how photosynthetically active radiation transmission is influenced by hoop house covering materials.	32.8	37.7	19.7	8.2	1.6	3.9	1.00
10	During the activity, I was a leader (active).	24.6	39.3	21.3	13.1	1.6	3.7	1.03
11	During the activity, I was a follower (passive).	11.7	26.7	25.0	20.0	16.7	3.0	1.28
12	During the activity, I was a spectator.	9.8	8.2	23.0	31.1	27.9	2.4	1.26
13	My group worked well together.	36.1	42.6	16.4	3.3	1.6	4.1	0.90
14	My group immediately grasped the tasks at hand.	24.6	42.6	16.4	13.1	3.3	3.7	1.08
15	This laboratory activity improved my appreciation for group activities.	29.5	34.4	18.0	14.8	3.3	3.7	1.14
16	I would recommend this laboratory for future HORT/AGRO 100G classes.	45.9	34.4	14.8	1.6	3.3	4.2	0.97
17	I will build my own hoop house at some point in the future.	29.5	21.3	31.1	11.5	6.6	3.6	1.22
18	Overall, I found this laboratory activity beneficial.	50.8	39.3	8.2	1.6	0.0	4.4	0.71

[z]SA = strongly agree; A = agree; U = undecided; D = disagree; SD = strongly disagree.
[y]Means were calculated from responses coded as SA = 5, A = 4, U = 3, D = 2, and SD = 1 on a Likert scale.
[x]Standard deviations were calculated from responses coded as SA = 5, A = 4, U = 3, D = 2, and SD = 1 on a Likert scale.

Table 2. Preplanned comparisons between two sets of three survey items administered in an Introductory Plant Science laboratory course as compared using the Wilcoxon signed-rank test. Associations were assessed using the nonparametric measure of association, Kendall's tau-b.

Preplanned comparison item no.[z]	Kendall's tau-b	*P* value
1–2	0.67	<0.0001
2–4	0.04	0.0006
1–4	0.34	0.0028
10–11	–0.24	0.0241
11–12	0.41	0.0001
10–12	–0.02	0.8393

[z]Item 1 = classroom material supported my learning of hoop house construction; Item 2 = laboratory material supported my learning of hoop house construction; Item 4 = I read the assigned material before the laboratory; Item 10 = during the activity, I was a leader (active); Item 11 = during the activity, I was a follower (passive); Item 12 = during the activity, I was a spectator.

nonparametric Kruskal–Wallis test. Only the test for one item (item 14) was significant, providing little evidence that the laboratory sections differed systematically from one another. Individual student responses were then pooled across laboratory sections for the formal analysis. Preplanned comparisons between two sets of three items [1, 2, 4; 10, 11, 12 (Table 2)] were made using the Wilcoxon signed-ranks test for individual student responses. The associations among these items were assessed using the nonparametric measure of association, Kendall's tau-b. Data were analyzed using SAS software (version 9.3; SAS Institute, Cary, NC), and significance was defined at $P \leq 0.05$.

Results and discussion

STUDENT-LEARNING OUTCOMES. The number of student responses in individual laboratory sections (5) varied from seven to 18 students for a total of 63 respondents (n = 63) of the 84 enrolled in the course at the beginning of the semester. Students who did not respond (25%) were likely absent on the day(s) of the laboratory activities or opted to not participate. Each laboratory section was taught by a different TA, each with varying degrees of experience with the Introductory Plant Science teaching materials. However, individual section means did not deviate from the overall combined laboratory means (Table 1), except for item 14 "my group immediately grasped the tasks at hand."

Only one survey question ("I have built a hoop house before taking this class") required a simple "yes" or "no" response (a non–Likert scale question) (Table 1). A majority of student respondents (53%) indicated they had never built a hoop house before the laboratory activity, however, 38% did not respond. Student respondents may have overlooked this particular question because it was isolated above the Likert-scaled questions presented in the survey (Table 1). Future survey tools should include all questions in a single block to avoid this issue. About 52% of students agreed or strongly agreed with the statement that they would build their own hoop house at some point in the future (item 17). In addition, more than 90% of students agreed or strongly agreed that they learned the basic techniques and practical application (95%) of constructing a hoop house after the exercise (items 5 and 6). These are very high percentages and similar to St. Hilaire et al. (2009) where students agreed or strongly agreed that they knew basic techniques (87%) and practical application (89%).

A majority of the students agreed or strongly agreed that the classroom materials [82% (item 1)], laboratory materials [82% (item 2)], and the laboratory instructor [88% (item 4)] supported their learning of hoop house construction (Table 1). Preplanned comparisons among these three items using the Wilcoxon signed-ranks test did not detect any differences. St. Hilaire et al. (2009) found similar responses where students agreed or strongly agreed that classroom materials (70%) and laboratory materials (81%) supported their learning. Nearly 62% of the students stated that they read the assigned materials before the laboratory activity began (item 3). The contributions of classroom materials, laboratory materials, and the laboratory instructor to student learning were positively associated with a stronger association between classroom materials (item 1) and laboratory materials (item 2) [Kendall's tau-b = 0.67, $P < 0.0001$ (Table 2)] than between classroom materials (item 1) and the laboratory instructor (item 4) [Kendall's tau-b = 0.34, $P = 0.0028$ (Table 2)] or laboratory materials (item 2) and the laboratory instructor (item 4) [Kendall's tau-b = 0.040, $P = 0.0006$ (Table 2)]. The observed stronger association between classroom and laboratory materials may relate to learning styles; individuals that benefit most from the types of materials provided in the classroom might also benefit more from the laboratory materials. It is important to note that despite the weaker associations between the two sets of material and the laboratory instructor, all three were rated similarly high, and all three should be incorporated to enhance student learning. However, all three factors were also associated with each other, and it appears the two types of written materials are more strongly associated than either is to the laboratory instructor. Effective teachers engage students and create a psychologically inviting learning environment by exhibiting frequent positive teacher immediacy behaviors (Roberts et al., 2012), and this may be more important for students or groups with heterogeneous learning styles (Lehman, 2007). Ewing et al. (2011) also found that instructor discourse had a positive impact on student cognition. Many learning style models exist, some of which are reviewed by Hawk and Shah (2007); VARK (visual, aural, read/write, and kinesthetic) is one that could have applicability to this study (Fleming, 2001). The student's placement on the reading/writing learning style preference scale likely influenced their assessment of both laboratory and course reading materials, explaining the relatively high association between those scores.

Students gained an appreciation for the scientific data collection and interpretation with 85% of respondents agreeing or strongly agreeing that instruments that measured environmental conditions were important for hoop houses (item 7). St. Hilaire et al. (2009) reported 73% in response to the same question. Similarly, more than 87% of the students agreed or strongly agreed that the hoop house covering materials (opaque or clear polyethylene) could modify the crop environment temperature (Fig. 2) and that those covering materials influenced *PAR* transmission (items 8 and 9).

Preplanned comparisons of statements concerning students' roles as leader (active), follower (passive), or spectator (items 10–12) during the activity revealed differences between all three item pairs (Table 2) with the highest agreement to the statement that the student was a leader (active) during the activity and the lowest agreement to the statement that they were a spectator. Sixty-three percent of respondents agreed or strongly agreed that they were a leader (active) during the activity. Thirty-eight percent of student respondents described themselves (agreed or strongly agreed) as a follower (passive) and 18% described themselves as a spectator. It is possible that students interpreted the words "leader" and "active," and "follower" and "passive" differently; also likely viewed "spectator" as a negative role, especially since the survey was conducted before grades for the course were completed; in spite of assurances that the survey was completely anonymous. During the 2-h hands-on activity, many students had peaks of activity to complete an ordered task, followed by necessary idle time. This mix of activities over time may further explain these contrasting data. There was a weak negative association between responses to survey items 10 (leader) and 11 (follower) [Kendall's tau-b = –0.24, $P = 0.0241$ (Table 2)], no association between items 10 (leader) and 12 (spectator) [Kendall's tau-b = –0.02, $P = 0.8393$ (Table 2)], and a positive association between items 11 (follower) and 12 (spectator) [Kendall's tau-b = 0.41, $P = 0.0001$ (Table 2)]. It is not unexpected that student respondents who rated themselves higher on item 10 (active) tended to rate themselves lower on item 11 (passive).

Most students (78%) agreed or strongly agreed that their group worked well together (item 13). This survey item result is similar to that of Burdett (2003) where 63% agreed that their groups worked well. Further, 67% of the students in the overall class felt that their group immediately grasped the tasks at hand (item 14). Although traditional group work is often viewed negatively by students (Bosworth and Hamilton, 1994), 64% of students felt that the laboratory activity improved their appreciation for group activities. This result is also similar to Burdett (2003), where 57% of business students agreed that their "experiences of formal, assessed group work have been positive." This result may indicate that experiential learning group work during scheduled class time could be a useful tool for team building and other learning experiences. In terms of future offerings and student recruitment, 90% found the laboratory activity beneficial and nearly 81% would recommend this activity for future Introductory Plant Science courses (Table 1).

To summarize, this exercise provided students with a real-world group work experience in hoop house construction, data collection equipment, and data interpretation as a part of a scheduled class meeting. Students perceived they achieved greater learning of the basic techniques and practical application of hoop house construction from this hands-on activity. However, it may not be realistic to build and take down the structures every semester. This activity could occur once a year. The students gained an appreciation for the scientific data collection and interpretation through this exercise. Finally, students' perception was of a positive experience working in groups indicating experiential learning group work was a useful tool for team building and learning. We conclude that integrating hoop house construction and data collection into an undergraduate general education plant science course can be an effective way to engage student learning.

Literature cited

Bosworth, K. and S.J. Hamilton (eds.). 1994. Collaborative learning: Underlying processes and effective techniques. Jossey-Bass, San Franciso, CA.

Burdett, J. 2003. Making groups work: University students' perceptions. Intl. Educ. J. 4:177–191.

Ewing, J.C., D.D. Foster, and M.S. Whittington. 2011. Explaining student cognition during class sessions in the context Piaget's theory of cognitive development. North Amer. Colleges Teachers Agr. J. 55(1):68–75.

Eyler, J. 2009. The power of experiential education. Liberal Educ. 95:24–31.

Fleming, N.D. 2001. Teaching and learning styles: VARK strategies. 1st ed. N.D. Fleming, Christchurch, New Zealand.

Grover, K. and S. Stovall. 2013. Student-centered teaching through experiential learning and its assessment. North Amer. Colleges Teachers Agr. J. 57(2):86–87.

Hawk, T.F. and A.J. Shah. 2007. Using learning style instruments to enhance student learning. Decis. Sci. J. Innovative Educ. 5:1–19.

Jimenez, D., R. Walser, and R. Torres. 2005. Hoop house construction for New Mexico: 12-ft. 40-ft. hoop house. New Mexico State Univ. Coop. Ext. Serv. Circ. 606.

Keeton, M.T. and P.J. Tate. 1978. The boom in experiential learning, p. 1–8. In: M.T. Keeton and P.J. Tate (eds.). Learning by experience: What, why, how. New directions for experiential learning. Vol. 1. Jossey-Bass, San Francisco, CA.

Kolb, D.A. 1984. Experiential learning: Experience as the source of learning and development. Prentice-Hall, Englewood Cliffs, NJ.

Lehman, M.E. 2007. Influence of learning style heterogeneity on cooperative learning. North Amer. Colleges Teachers Agr. J. 51(4):17–22.

Millenbah, K. and J. Millspaugh. 2003. Using experiential learning in wildlife courses to improve retention, problem solving, and decision-making. Wildlife Soc. Bull. 31:127–137.

Montgomery, R.A. and K.F. Millenbah. 2011. Examining whether learning space affects the retention of experiential knowledge. J. Nat. Resources Life Sci. Educ. 40:45–50.

Paul, P. and K. Mukhopadhyay. 2005. Experiential learning in international business education. J. Teach. Intl. Bus. 16:7–25.

Roberts, T.G., N.W. Conner, C.M. Estepp, A. Giorgi, and C.T. Stripling. 2012. Examining the teaching behaviors of successful teachers in a college of agricultural and life sciences. North Amer. Colleges Teachers Agr. J. 56(2):21–28.

St. Hilaire, R., T.W. Sammis, and J.G. Mexal. 2009. Integrating hoop house construction and operation into an undergraduate general education horticulture class. HortTechnology 19:445–451.

Specht, L.B. and P.K. Sandlin. 1991. The differential effects of experiential learning activities and traditional lecture classes in accounting. Simul. Gaming 22:196–210.

Van Eynde, D.F. and R.W. Spencer. 1988. Lecture versus experiential learning: Their differential effects on long-term memory. J. Mgt. Educ. 12:52–58.

Walker, S., M. Uchanski, and D. Jimenez. 2012. Hoop house vegetable production. New Mexico State Univ. Coop. Ext. Serv. Guide H-252.