

# Teaching Methods

## Are Learning Styles, Study Habits, and Performance Correlated in Woody Plant Identification Students?

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**SUMMARY.** New technologies such as online databases, interactive dichotomous keys, and online courses have changed the way some plant identification courses are delivered. These changing resources may create discrepancies between traditional instruction of landscape plant materials courses and the way modern students learn, which may result in students not meeting their potential. However, what resources students are using to study plant materials is unclear. We investigated the relationship between learning styles, study habits, and performance of students during two terms of woody landscape plant materials courses. To assess these relationships, we determined the characteristics of the participants and their preferred study method throughout the duration of the term as well as correlations between 1) preferred learning styles and performance, 2) preferred learning styles and preferred study method, and 3) performance and preferred study method. The participants in this study ( $n = 31$ ) consisted of 14 males and 17 females. Of the 31 participants, 3 were freshmen, 3 were sophomores, 16 were juniors, 7 were seniors, and 2 were graduate students. Based on preference scores for learning style, 15 students were identified as visual learners, 3 as auditory, and 13 as kinesthetic learners. No significant relationships were observed between preferred learning style and performance or between preferred learning style and preferred study method. The two preferred study methods were using branch samples collected by the instructor and notecards created by students. No relationship existed between preferred study method and performance in the course. Our study provides information on study methods of woody plant identification students enrolled in a site-based course. We did not observe statistically significant relationships among preferred learning style, preferred study method, and course grade, but anecdotal evidence indicated students who prepared their own study aids by making notecards scored better in these courses.

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New technology has changed instruction techniques in plant materials courses. Technology used in plant materials courses includes graphically based interactive systems using dichotomous keys (Shaw, 1993), database management software (Boufford, 1994), interactive online tools for instruction (Campbell et al., 2011), and web-based courses

(Teolis et al., 2007). Web-based courses are becoming more common, and even in site-based courses, students are using more online resources. These technological changes may challenge traditional methods of teaching landscape plant identification courses. For instance, students may spend substantial amounts of time studying digital resources that may not help them become more familiar with the actual identification characters of the plants. Therefore, we should examine how students prefer to learn and how students are actually spending their study time in horticulture courses. The results may provide valuable insight, as we seek to develop engaging and interactive coursework delivered in classroom, hybrid, or web-based learning environments.

To address this issue, our study focused on student learning styles. The theories and research surrounding learning styles are confusing. Cassidy (2004) voiced a similar viewpoint and believed that researchers should enter the area of learning styles with a sense of trepidation because of the volume of different theories relating to learning styles. De Bello (1990) reiterated the confusion surrounding learning styles by noting there are almost as many definitions as there are theories, and yet emphasized that operationalizing of learning style was a necessary but highly problematic endeavor.

Keefe (1979), in association with the National Association of Secondary School Principals, attempted to formulate a comprehensive definition by addressing learning style as a mix between the cognitive, affective, and physiological factors that influence how learners perceive, react with, and respond to the learning environment. Dunn et al. (1989) believed that learning style is shaped by both biological and developmental factors, and as a result, some teaching methods may be effective for some and ineffective for others.

As we designed this study, we focused on identifying student learning style preferences along three domains: visual, auditory, and kinesthetic (VAK). Once the learning styles were identified, we provided students the opportunity to use a variety of study methods in an attempt to respect the diverse ways of learning of our students. Within the context of horticulture classes, we considered the unique

aspects of the curriculum and the inherently hands-on applied components. Unlike other subject areas, the study of landscape plants lends itself to all three domains depending on the teaching strategies of the instructor. In this study, the instructor presented the material to address all three learning style areas. PowerPoint® (version 14.2.4; Microsoft Corp., Redmond, WA) lectures included images of plants to be observed, and the instructor verbally described key identification characters, which provided both auditory and visual instruction. Students were then led on a landscape tour of the plants, and the instructor reiterated those identification characters, pointed out visual characters, and gave students opportunities to touch and smell plants in situ, which provided VAK learning opportunities. Students were allowed to pick the study methods they preferred independent of their learning style identified using the VAK instrument described below. This means even if a student was identified as a strong auditory learner based on the instrument, they were free to select a kinesthetic study method.

Our study was designed to determine if different study techniques affected student performance in woody landscape plant materials courses. The specific objectives of this study were to determine the relationships among study technique, overall grade point average (GPA), learning style, and performance. To assess these relationships, we determined the characteristics of the participants and their preferred study method throughout the duration of the term as well as correlations between 1) preferred learning styles and performance, 2) preferred learning styles and preferred study method, and 3) performance and preferred study method.

## Materials and methods

Students in two 10-week-long plant identification courses were surveyed during 2011. These courses were HORT 226 taught during Fall term 2011 and included 158 plants, primarily deciduous hardwood trees and conifers, and HORT 228 taught during Spring term 2011 and included 190 plants, emphasizing spring flowering trees and shrubs. The instructor and methods were the same for both terms. Plant lists and PowerPoint® slides were uploaded to Blackboard

(Blackboard, Washington, DC), an online course management program, and students had access to these after the first day of the term. During each class period (110 min), students were introduced to plants in a classroom and were shown slides. Specific identification characters and various cultural and landscape use attributes were emphasized. Students then toured campus and surrounding areas to see the plants introduced in the classroom. The classroom portion of lectures lasted 35 to 45 min, and the campus tour used the remaining 65 to 75 min. In addition, samples of plants from each lecture were collected by the instructor and placed in glass jars in a common area accessible to students from the time they were introduced until students were quizzed on them. Finally, students were directed to use other resources including a website (Oregon State University, 2012), the course textbook (Dirr, 2009), and creating their own notecards. Notecards' content varied among students and the instructor did not give specific guidelines. Notecards varied from those that only listed names of plants to those that made line drawings and detailed morphological information distilled from lectures and other references.

Course grade (performance) was determined by plant identification quizzes as well as exams that included culture and plant use information, nomenclature, and anatomical terms. The largest portion of course grade was derived from identification quizzes conducted in a teaching laboratory. Students were required to provide the Latin binomial, common name, family name, and cultivar or variety, when applicable. Identification quizzes made up 75% of students' final grade. Culture and landscape plant use information included on midterm and final exams contributed another 6.25% to final grade; therefore, plant knowledge per se was 81.25% of students' final grade. There was a strong relationship between students' scores on identification quizzes and exams (data not shown).

**INSTRUMENTATION AND COLLECTION.** The VAK assessment (Chislett and Chapman, 2005) that we used was adapted from the visual, aural, read/write, and kinesthetic instrument (Fleming and Mills, 1992). The VAK determines students' preferences for a given learning style. Fleming and Mills (1992) indicated

the VAK provides a simple way for teachers to reflect on how they present information.

The VAK consists of 30 statements that assess a student's response to a particular situation. Each question has three response options that relate to the three styles of learning. For example, students are presented with a one to two sentence scenario and then asked how they prefer to respond. The statement, "I tend to say," is followed by three response options of "I see what you mean," "I hear what you are saying," and "I know how you feel." Student responses are indicative of their preferred learning style. The student responses are then compiled to indicate their percentage preference toward a given style. Percentage preferences were used because some students actually employed a relatively heterogeneous mix of the three styles (Fleming and Mills, 1992). For example, if a student's preference is a mix of 30% visual, 20% auditory, and 50% kinesthetic based on the VAK, the student would be identified as a kinesthetic learner even though that is not their sole learning style.

Students were given the VAK learning styles assessment during the first week of each term. The students provided some descriptive data as well (e.g., GPA, expected course grade, etc.). To ensure objectivity and anonymity, the administration of all research instruments was conducted by a researcher who had no affiliation with the students or the course. A biweekly assessment asked questions pertaining to the methods used by students while studying. Students had the option to select the length of time and the study method they employed during the prior 2 weeks. Students also had an open-ended descriptive category where they could add additional study methods as well.

**DATA ANALYSIS.** Correlation coefficients were determined using SPSS (version 19; IBM Corp., Armonk, NY) and described using the adjectives defined by Bartz (1999). Bartz defined 0.80 or higher as very high, 0.60–0.79 as strong, 0.50–0.59 as moderate, 0.20–0.49 as low, and 0–0.19 as very low.

## Results and discussion

The participants in this study ( $n = 31$ ) consisted of 14 males and 17 females. Of the 31 participants, 3

were freshmen, 3 were sophomores, 16 were juniors, 7 were seniors, and 2 were graduate students. Based on preference scores, 15 students were identified as visual learners, 3 as auditory, and 13 as kinesthetic learners. Relating to cumulative GPA, 80% of the participants indicated a GPA greater than 2.50 and 61% of the participants expected to obtain an A in the course.

Final grades for students in the course included students with the following percentage of total points available: 10 students  $\geq 91\%$ , 5 students 83% to 88%, 6 students 72% to 78%, 3 students 65% to 67%, and 7 students  $\leq 50\%$ . Students' grades were not solely determined by plant identification skills, but the relationship between performance on identification quizzes and final grade was strong (data not shown). Including or removing the material on midterm and final exams that was not plant material knowledge per se would not alter results.

No significant correlations ( $P \leq 0.05$ ) existed between course grade and learning style. We observed low correlations (0.20 to 0.49) between course grade and visual and auditory learning styles and a very low (0 to 0.19) relationship between kinesthetic style and course grade (Table 1). Collectively, the VAK learning styles explained 13.4% of the variance in the students' ending course grade.

Visual and auditory learning styles had low correlations with course grade. Visual learning style and course grade were negatively correlated. This indicates as the student preference for the visual learning style increased, the course grade decreased. Students may have, based on their preference for a visual learning style, overestimated their ability to recall plant names during course quizzes and tests.

A very low to low correlation existed between learning styles and preferred study method (Table 2). Students who preferred a visual learning style did not use the live plants, collected samples, website, or notecards as readily as those with auditory and kinesthetic learning style. As student preference for the visual learning styles increased, their use of these study methods tended to decrease slightly. On the other hand, students with an auditory learning style showed positive correlations with collected samples and use of the website. Students with a kinesthetic learning style

**Table 1. Correlation between course grade and the visual, auditory, and kinesthetic learning style preferences for 31 students enrolled in two woody landscape plant materials courses.**

		Visual	Auditory	Kinesthetic
Course grade	Pearson correlation	-0.23	0.27	0.12
	Coefficient of determination ( $r^2$ )	0.05	0.07	0.01
	Significance (two-tailed)	0.26	0.18	0.57

**Table 2. Relationships between learning style preferences and student study method for 31 students enrolled in two woody landscape plant materials courses.**

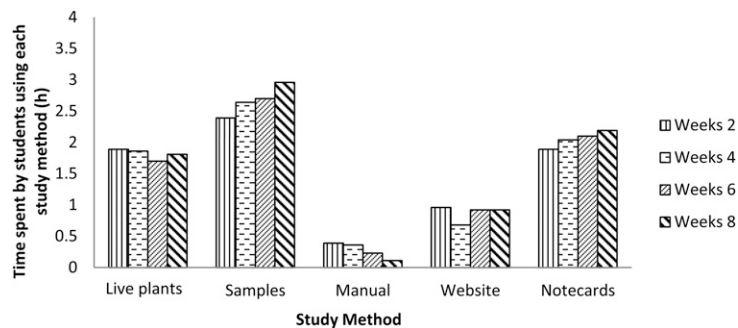
		Live plants <sup>z</sup>	Collected samples <sup>y</sup>	Website <sup>x</sup>	Notecards <sup>w</sup>
Visual	Pearson correlation	-0.11	-0.07	-0.29	-0.09
	Coefficient of determination ( $r^2$ )	0.01	0.01	0.09	0.01
	Significance (two-tailed)	0.58	0.72	0.13	0.66
Auditory	Pearson correlation	-0.01	0.27	0.21	-0.15
	Coefficient of determination ( $r^2$ )	—	0.07	0.05	0.02
	Significance (two-tailed)	0.96	0.17	0.28	0.46
Kinesthetic	Pearson correlation	0.05	-0.12	0.14	0.21
	Coefficient of determination ( $r^2$ )	0.00	0.01	0.02	0.04
	Significance (two-tailed)	0.82	0.55	0.46	0.29

<sup>z</sup>In situ plants in the landscape.

<sup>y</sup>Samples collected by instructor and placed in a common study area accessible to students.

<sup>x</sup>Oregon State University, 2012.

<sup>w</sup>Notecards were created by students and varied from student to student with regard to content.



**Fig. 1. Hourly preferred study methods for 31 students during the course of two 10-week terms of woody landscape plant materials classes. “Live plants” are in situ plants in the landscape, “samples” are branch samples collected by the instructor, “manual” refers to Dirr (2009), “website” refers to Oregon State University (2012), and “notecards” are personal study cards generated by individual students.**

preference yielded a positive correlation with website and notecard use. The correlation between kinesthetic and notecards is somewhat intuitive. Students who prefer movement while they learn seem to also prefer notecards.

The majority of students studied using collected samples, notecards, and live plants in the landscape (Fig. 1). Use during the term increased for collected samples and notecards. Very few students used the suggested text for the course to study, and its use decreased over the term. It should be noted that the course textbook did

not contain color photographs, only line drawings to depict leaf characters and perhaps students would be more inclined to use a text that includes color photographs.

Students in these courses preferred collected samples and indicated spending 2.5 h or more per week analyzing collected samples. Student use of these samples is encouraging and provides a basis to support continued collection in this manner. Students indicated they found it useful to be able to compare similar species side by side. We believe the ability to easily compare morphologically similar taxa

**Table 3. Correlation coefficients and corresponding significance level between course grade, overall grade point average (GPA) and the hours students spent studying live plants, collected samples, a website, and notecards for 31 students enrolled in woody landscape plant materials courses.**

GPA	Live plants <sup>z</sup>	Collected samples <sup>y</sup>	Website <sup>x</sup>	Notecards <sup>w</sup>	Overall
Course grade	0.23	0.11	0.05	0.37	0.31
Significance (two-tailed)	0.24	0.59	0.80	0.06	0.12

<sup>z</sup>In situ plants in the landscape.

<sup>y</sup>Samples collected by instructor and placed in a common study area accessible to students.

<sup>x</sup>Oregon State University, 2012.

<sup>w</sup>Notecards were created by students and varied from student to student with regard to content.

is among the main reasons students chose this study method.

The second most used study method was notecards. Students used notecards over 2 h per week throughout the quarter. Based on student use and the anecdotal observation that their use increased course grade, we recommend that future instructors increase focus on the use of notecards. Several students used electronic notecards. The instructor did not include them as a recommendation during the study; however, electronic notecards may be a more effective way for students to quiz themselves than traditional notecards.

During the weekly lectures, the students visited live plants identified with the aid of the instructor and had the opportunity to engage all of their senses to learn plants. These “plant walks” allowed students to take notes and revisit the live plants at any time.

The least used study methods included the website at less than 1 h per week and the text (Dirr, 2009) was used less than 30 min per week. As course instructors consider how best to allocate time and resources for student learning, careful consideration should be given to the utility of texts and websites. Our findings indicate that the text and website cited here were of less utility to students than other study techniques. Perhaps more interactive websites, smart phone apps, or full color texts would be of more utility to students. For example, FloraGator (Wilson and Flory, 2012) is a more interactive tool for plant identification than the website recommended to students, and it may be more appealing and useful by encouraging more active learning. It should be noted that at least one study has shown that students receiving traditional live instruction scored better on herbaceous plant identification quizzes than students receiving web-based instruction (Teolis et al., 2007).

The extent to which students prefer a given learning style was not assessed in the current study, and students were classified based on overall preferences. Thus, a student may have only a slight percentage preference for a given learning style, which decreased the amount of variance among student scores in all three learning styles. This increase in the covariance among the variables reduced the overall correlation and made it more difficult to both assess and interpret. For instance, a student may have been identified as 30% auditory, 30% visual, and 40% kinesthetic based on the VAK. In terms of preference, this student would be identified as kinesthetic; however, practically speaking, the student preference scores are relatively heterogeneous. The covariance, or heterogeneity, among the learning styles preferences will reduce the overall correlation.

Very low to moderate correlations existed among preferred study method, course grade, and overall GPA (Table 3). Among study methods, use of notecards had the highest correlation to student course grade (0.37), although it was not significant. Overall, as students’ use of notecards increased, their course grade also increased. While this is not a cause and effect statistic, it does show a relationship between the two variables. Notecard use is also moderately correlated (0.45) with overall student GPA. Perhaps, students who are motivated enough to create their own notecards also pursue study methods in other courses which contribute to their overall GPA. Another factor could be that use of notecards requires students to focus more thoroughly on the information, as writing is a more active form of studying, and requires the student to focus more than reading or listening. Both live plants and

collected samples were minimally correlated with course grade.

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