A Comparison of Web-Based and Traditional Instruction for Teaching Turfgrass Identification[1]

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Abstract

Web-based instruction is growing at a rapid rate, but the ability to effectively teach lab skills in a web-based format may be a barrier to the development of distance education courses in turfgrass management. We conducted a study to compare the effectiveness of web-based versus traditional instruction for teaching turfgrass identification (ID). An introductory horticultural science class with four lab sections and a total enrollment of 88 students was the study setting. Quiz scores showed no difference in ability to identify live specimens of six turfgrass species between students receiving web-based versus traditional instruction. However, students receiving traditional instruction performed better on knowledge-based questions, in which they were asked to name which species corresponded to a written set of ID characteristics. Results suggested that web-based students' performance on knowledge-based questions may be improved by finding ways to increase their interaction with the content. Student performance on live-specimen ID or knowledge-based questions was not correlated with time spent studying, or students' perceived importance of turfgrass identification, but it was correlated with confidence level. Our results show that web-based formats can be as effective as traditional methods in teaching students to ID live turfgrass samples.

Introduction

Distance education, and particularly web-based instruction, is growing at a rapid rate at colleges and universities worldwide. At Kansas State University, the number of credit hours offered via distance education increased more than 70% from 2002 to 2010, and the number of students enrolled in such courses increased more than 80% (Minshall, B., personal communication). The vast majority of these new courses are offered in a completely web-based format. As web-based instruction spreads into the sciences, course developers must grapple with the question of whether material traditionally taught in a "hands-on" laboratory environment can be effectively taught in a web-based format. In horticulture, turfgrass identification (ID) is an example of such a skill. Turfgrass ID is challenging because many of the structures used in the identification process are too small to be easily discerned with the naked eye (Christians, 2007). This skill has traditionally been taught in a face-to-face format in which students use hand lenses to view live plants, with an instructor present to provide guidance. As distance offerings of horticulture courses become more widespread, the effectiveness of teaching skills such as turfgrass ID in an online environment must be investigated.

Web-based instruction has some distinct advantages, for example, it allows students 24 hour access to course materials. Such access may increase the amount of time students spend studying the subject. Jeannette and Meyer (2002) found that online learners spent 20% more time studying than face-to-face students. Not surprisingly, that increased study time translates to better performance. In a study comparing student performance in online versus face-to-face sections of an introductory turfgrass management course, Bigelow (2009) found that time spent online was positively associated with course grade (R^2 = 0.76). Another advantage of web-based instruction is that online lectures allow the student flexibility to start, stop, and review lectures at any time. Miller and Honeyman (1994) demonstrated that students will take advantage of such opportunities: In an off-campus agricultural degree program, they found that 54% of students watched videos more than once.

While the online learning environment provides the student with great flexibility, student-student and

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student-teacher interaction is limited. Vavala et al. (2010) found that students in online courses lacked a sense of community. Other researchers have shown that students are more comfortable in a traditional classroom and desire more interaction with their peers and teacher (Schroeder-Moreno and Cooper, 2007). The interaction that occurs in the traditional classroom may help students persevere in learning difficult tasks such as turfgrass ID. However, despite the decreased interaction, online students' perception of learning and average course grade were not significantly different from students in traditional courses (Vavala et al., 2010).

Because turfgrass ID structures are difficult to see without magnification, web-based instruction facilitates the use of magnified images in a manner that unambiguously shows students the structures they need to learn. While reference books often contain images, they are frequently inadequate or incomplete (Kling et al., 1996), or are not organized in a way that optimizes learning for a particular class.

Computer-aided instruction has been shown to be an effective plant ID teaching tool (McCaslin and Na, 1994; Seiler et al., 2002), but when researchers have investigated the efficacy of a completely web-based approach results have been poor. Taraban et al. (2004) and Teolis et al. (2007) found that students receiving live instruction in woody and herbaceous plant ID had higher quiz scores (quizzes included both live samples and photographs) than students receiving web-based instruction. These studies used woody or herbaceous plants (our review of peer-reviewed literature revealed no research involving turfgrass ID) and web-based students did not have live plants to study. Clearly, the research shows that studying live plants leads to better performance. However, since computer-aided approaches help students learn plant ID better, it seems reasonable to combine the approaches; that is, web-based instruction would ideally be used in tandem with live samples for students to study. For distance students, that would entail providing them plants. If the course being taught via distance were woody or herbaceous plants, providing live samples would be extremely challenging because of the size and number of plants involved. But with turfgrass ID, typically only 15-20 species are taught, and distance students could be sent plugs through the mail, which they could transplant into small pots for studying. A challenge with turfgrass ID is that plants usually have much smaller ID structures which are more difficult to see than those on the typical woody or herbaceous ornamental. The objective of our research, then, was to compare the efficacy of web-based instruction with traditional instruction for teaching turfgrass ID, in a scenario where all students had access to live plants for studying.

Because the goal of teaching turfgrass ID is that students will be able to identify live plants, the criterion used to measure teaching method efficacy was live turfgrass plant ID. In addition, we investigated whether teaching method influenced students' ability to answer "knowledge" questions about turfgrass ID. Our hypothesis was that, given access to live turfgrass samples for study, students receiving web-based instruction would do as well as, or better than, students receiving traditional instruction on both live plant ID and knowledge questions. This hypothesis was based on the perceived advantages of the web-based format for enabling students to easily see and review the very small structures used in turfgrass ID, and the ID characteristics for each grass.

Materials and Methods

This study was conducted in the fall semester of 2010. The study was deemed exempt under federal regulation 45 CFR 46.101 (b) (1). Participants were undergraduate students enrolled in Principles of Horticultural Science at Kansas State University, Manhattan, KS. The course is an introduction to college-level plant science and has both lecture and laboratory components. Total enrollment in the course was 88, and the students were divided into four laboratory sections. Sixty-one percent of the students in the course were horticulture majors, 18% were other agriculture majors, and 20% were non-agricultural majors. By class, there were 52% freshman, 25% sophomores, 14% juniors, and 9% seniors. One of the laboratory sessions focused on turfgrass ID, and two instructional methods were used: traditional (face-to-face) or web-based. Two of the laboratory sections were randomly selected to receive traditional instruction and the other two sections received web-based instruction. The instructor for all sections was the same and was experienced in turfgrass ID, having taught turfgrass management for over 10 years. Students were taught to identify six cool-season turfgrass species: annual ryegrass [*Lolium multiflorum Lam.*], creeping bentgrass [*Agrostis stolonifera L.*], Kentucky bluegrass [*Poa pratensis L.*], perennial ryegrass [*Lolium perenne L.*], smooth bromegrass [*Bromus inermis Leyss.*], and tall fescue [*Festuca arundinacea Schreb.*]. These grasses were selected because correct ID required students to use a wide range of vegetative turfgrass ID characteristics, such as vernation, ligules, auricles, appearance of leaf veins, midribs, leaf tip shape, and texture (Christians, 2007). A PowerPoint presentation

was developed to teach students the ID characteristics, and to show students how to view the characteristics on each grass. High quality, magnified images were used.

In the traditional sections, each pair of lab partners was provided live samples of each species in 13-cm dia. pots (reproductive structures were not present, as the goal in turfgrass management is to learn ID by vegetative structures only), a handout listing important ID terms with space to take notes on each grass, and 8x hand lenses. The instructor used the PowerPoint presentation, in combination with the live samples, to teach the ID characteristics. The students used the live samples to practice, and the instructor provided individual help when students had difficulty seeing any particular characteristic. The key vegetative characteristics for each species were summarized in the PowerPoint presentation and were reviewed by the instructor while students viewed and took notes on the live samples. After lab, the live samples were placed in a greenhouse to which the students had access from 7 am to 6 pm, 7 days a week. Additional samples of each species, growing in 0.15 m^2 flats, were also placed in the greenhouse for the students to study.

In the web-based sections, students were told to view, on their own, an online presentation to learn how to ID the grasses. The presentation consisted of a PowerPoint recording of the same presentation that was used in the traditional sections. Camtasia Studio software (TechSmith Corp., Okemos, MI) was used to record the presentation. The software enabled the instructor to add voice audio to the presentation, and to annotate the presentation with a highlighted pointer. Web-based students accessed the identification presentation, published as an MP4 file, from K-State Online (http://public.online.ksu.edu), which is a web-based learning management system used at Kansas State University. All students were familiar with the system because it had been used to post lectures, announcements, grades, etc. in the weeks prior to the turfgrass ID lab. The lab handout was also posted for the web-based students, so they could take notes. Students in the traditional sections did not have access to the recorded presentation. Web-based students had access to the same plants in the greenhouse as the traditional students did, so that they could study live plants on their own. This was intended to simulate a distance learning situation in which students were mailed live plants to study. All students were required to complete a preliminary open-notes quiz within 48 hours of their section meeting time. The purpose of the open-notes quiz was to motivate the web-based students to promptly study the recorded ID presentation. The open-notes quiz was worth 2% of the total course lab grade, and was administered through K-State Online.

During the next laboratory session (one week later), students were given a closed-book ID quiz worth 7.5% of the total course lab grade. For this quiz, students were required to ID live samples of the grasses. Each of the six grasses was included on the quiz two to three times for a total of 15 live samples. Students were told that the quiz contained multiple samples of some or all grasses, but they were not told how many samples of each grass were included. The quiz also included six knowledge-based questions in which students were given a vegetative description and asked to name the grass with that set of characteristics (e.g., "Which species has the following characteristics? rolled vernation; auricles are absent; tall membranous ligule; narrow leaf with no midrib; very prominent venation). Finally, students were asked to respond to four survey questions to assess their confidence, preparedness, and motivation level for learning turf ID (Table 1). In response to ID and knowledge questions students were required to write the common name only. Eleven students were excluded from the statistical analysis because they either did not come to class on the day turfgrass ID was taught (for the traditional group), or because they did not complete the preliminary open-notes quiz. Therefore, for the statistical analysis there were 37 students in the traditional group and 40 in the web-based group. ID quiz scores were subjected to analysis of covariance with the students' overall course grade as the covariate. Performance on the live-specimen and knowledge-based questions between the traditional and web-based groups was analyzed with t-tests. For survey responses, means and standard errors were calculated. Pearson correlation coefficients were determined to identify correlations among survey responses and ID quiz scores. All analysis was conducted using SAS 9.2 (SAS Institute, Inc., Cary, NC, USA).

Results and Discussion

There was no difference in performance on live-specimen ID between the traditional and web-based groups (Table 2). This result was in agreement with our hypothesis that students receiving web-based instruction would do as well as, or better than, students receiving traditional instruction. However, the overall performance of students in both groups was somewhat poor, with mean scores of 57.5 and 59.2%, respectively. The low mean scores may partially reflect the inherent difficulty of turfgrass ID, and the fact that the six grasses used in the study were purposely selected because they would be difficult to discern

Table 1. Summary of Likert-type Responses to Survey Questions Asked of Traditional and Web-based Students before and during a turfgrass ID Quiz to assess their Confidence, Study time, and Motivation for Learning turfgrass ID

	Responses(%)					Teaching Method Traditional (n=37)	Teaching Method Web-based (n=40)
Survey Question	1	2	3	4	5	Mean±SE	Mean±SE
How confident are you that you will be able to correctly identify the six grasses?[zy]	0	8	29	55	8	3.7±0.1	3.6±0.1
How much time did you spend studying the PowerPoint presentation and/or your notes?[x]	0	21	43	27	9	3.2±0.1	3.3±0.2
How much time did you spend studying the live grass samples?[x]	18	60	19	1	1	2.1±0.1	2.1±0.1
How important do you fee turfgrass ID will be to you in your future career?[w]	13	22	30	16	19	3.2±0.2	2.9±0.2

[z]Students responded to this question just before taking the ID quiz.

[y]Likert-type scale used for responses to this question: 1= not confident at all-- I doubt I'll get any correct; 2= not very confident-- I might only get one or two correct; 3= somewhat confident-- I might get about half correct; 4= confident-- I expect to get most of them correct; 5= very confident-- I expect to get them all correct.

[x]Likert-type scale used for responses to this question: 1= none; 2= less than 1 hr; 3= between 1 and 2 hr; 4= between 2 and 3 hr; 5= more than 3 hr

[w]Likert-type scale used for responses to this question: 1= not very important at all-- I won't need to know it; 2= only slightly important-- it might rarely be of use to me; 3= somewhat important-- it could occasionally be useful to me; 4= important-- it will definitely help me do my job better; 5= very important-- I won't be able to do my job without it.

from one another without learning the full range of ID characteristics well.

While there was no difference in performance on live-specimen ID, we were surprised to find that the traditional group had a higher mean score on the knowledge-based questions than the web-based group (Table 2). This finding was counter to our hypothesis, stated above. We had formulated our hypothesis based, in part, on the perceived advantage of the web-based format for allowing students to easily review material. Miller and Honeyman (1994) had found that over half of students in distance courses viewed recorded lectures more than once. While we did not monitor the number of times our web-based students watched the recorded lecture, we did ask the following survey question: "How much time did you spend studying the PowerPoint presentations and/or your notes?" Responses to this question indicated that both groups studied about the same amount of time, with both groups averaging between one and two hours (Table 1). One possible explanation for the difference in performance on knowledge-based questions is that traditional students' study time was preceded by the laboratory time during which they were exposed to the material. For web-based students, their total exposure to the material was likely limited to the one to two hours (on average) of study time they reported. Web-based students' performance on knowledge-based questions may be improved by finding ways to increase their time spent studying or interacting with the material, perhaps by including interactive exercises in which they are forced to use the material and to write down key points. Bigelow (2009) previously reported that time spent online was positively associated with performance in web-based courses.

Table 2. Mean scores on live-specimen and knowledge-based turfgrass ID questions when students were taught by traditional or web-based methods

	Teaching Method Traditional	Teaching Method Web-based	
Question type:	Score(%)±SE		t-text[x]
Live-specimen ID	57.5±4.1	59.2±3.3	NS
Knowledge-based	86.0±3.7	71.7±3.9	*

[z]n = 37 students

[y]n = 40 students

[x]NS, * Non-significant or significant at p = 0.05, respectively.

It is also possible that the more structured environment for the traditional group led to better note-taking. They may also have felt more urgency in taking notes, because they did not have access to a recorded presentation for later referral, as the web-based students did. Conversely, the web-based students may have been less diligent in taking notes because they had access to the recorded presentation.

In the end, while the improved performance of the traditional group on knowledge-based questions is intriguing, we want to re-emphasize that the ultimate goal in teaching turfgrass ID is that students will learn to ID actual grass plants, and the traditional group did not do better than the web-based group in that regard.

If better performance on knowledge-based questions does not necessarily translate to improved ability to ID live plants, then it would seem that time spent studying actual grass samples would be the most important factor. There was no difference between groups in the amount of study time spent on live grass samples—both groups reported a mean study time of less than one hour (Table 1). Since there was no difference between groups in performance on live-specimen ID, it is not surprising to find that their mean study time with live samples was similar. Correlation analysis failed to show a relationship between study

time with live samples and performance on live-specimen ID for either group (Table 3). However, we suspect this is due to the fact that the "study time with live samples" question yielded very few responses in the 4-5 range—97% of the responses were in the 1-3 range, with 60% of the responses being "2" (Table 1). In other words, there may not have been a sufficient range in study time among the students to detect a correlation.

Both groups were also similar in the perceived importance of turfgrass ID to their future career (Table 1), with the mean response being close to 3 (i.e., "somewhat important"). There was no correlation between perceived importance of turfgrass ID to their future career and performance on either knowledge-based or live-specimen ID.

The confidence level of the students was fairly high, with the mean response to the question, "How confident are you that you will be able to correctly identify the six grasses?" being nearly 4 (i.e., "confident—I expect to get most of them correct") (Table 1). Again, there was no difference in confidence level between the groups. Based on their live-specimen ID performance, it is probably fair to say that the students were overconfident as a group. Twenge (2006) has identified overconfidence as a common characteristic of today's college-age young people. Going into this project, we had wondered if students in the web-based group might be less confident because of their lack of direct contact with an instructor in learning a challenging task such as turfgrass ID. These results show that web-based students did not, in fact, have lower confidence in their ability to ID turfgrasses. Familiarity with the internet is another characteristic of this generation and may help explain the high confidence level of web-based students, in particular.

There were significant correlations between confidence-level and performance on both knowledge-based and live-specimen ID (Table 3). While the strength of the correlations was only moderate, they nevertheless indicate that students had a sense for how well they had learned turfgrass ID relative to their peers. This suggests that looking solely at study time to explain performance is insufficient, because students vary in their academic ability. Some students were apparently able to spend an hour or less studying live samples and learn to ID the six grasses quite well, while others were not successful in that amount of time. These differences in academic ability are probably reflected in the students' confidence-level, and therefore in the significant correlation between confidence-level and performance on the ID questions.

Table 3. Pearson Correlations of turfgrass ID Performance with Confidence, Study time, and Perceived Importance of Turfgrass ID, when Students are taught by Traditional or Web-based Methods

	How confident are you that you will be able to correctly identify the 6 grasses? [z]	How much time did you spend studying the PowerPoint presentation and/or your notes?	How much time did you spend studying the live grass samples?	How important do you feel turfgrass ID will be to you in your future career?
Traditional Teaching				
Knowledge-based ID	0.34*	0.07	0.05	0.05
Live-specimen ID	0.43**	-0.24	0.06	0.07
Web-based Teaching				
Knowledge-based ID	0.37*	0.16	-0.06	0.27
Live-specimen ID	0.35*	0.05	0.22	0.24

[z]Students responded to this question just before taking the ID quiz.
* and ** Significant at 0.05 and 0.01, respectively.

Summary

There was no difference in performance on live-specimen ID between students taught traditionally and in a web-based format. Overall performance on live-specimen ID by both groups was relatively poor, with the mean scores falling just below 60%. This may reflect the inherent difficulty of turfgrass ID, along with the fact that the grasses used in our study were selected specifically because they were difficult to tell apart without learning and using structures that are not easily seen without magnification. In any case, our results show that web-based instruction does not put students at a disadvantage when learning to ID live turfgrass plants.

Traditionally taught students performed better on knowledge-based ID questions than their web-based counterparts. A possible reason for the higher performance of the traditional group on knowledge-based questions is that they spent more overall time interacting with the information; both groups reported equivalent study time with PowerPoints and/or notes, but the traditional groups' study time was preceded by learning time in the laboratory, which was not the case for the web-based group.

Nevertheless, improved performance on knowledge-based questions did not lead to improved performance on live sample ID, which is the goal in turfgrass ID. In addition to the difficulty factor, the relatively poor overall performance on live-specimen ID was probably related to insufficient study time with live samples, as both groups reported mean study time of less than one hour. Future studies should investigate

ways to increase the quality and/or duration of students' study time with live samples.

Web-based students were just as confident as traditional students that they would be able to ID live specimens. Today's college students do not appear to be intimidated by the prospect of learning turfgrass ID in a web-based format.

In summary, our results show that students who are taught turfgrass ID in a web-based format are not disadvantaged compared to traditionally taught students, as long as they are provided live samples for study. However, there is much room for improvement in performance with live-specimen ID, and future research should focus on ways to improve this performance.

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