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From the Field

Teaching Wildlife Techniques to Millennials With a Flipped Classroom

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ABSTRACT Millennials prefer to learn by working in groups, using technology, engaging in real-world issues, and discussing course content. To accommodate and engage these learning preferences, I modified the traditional Wildlife Techniques lecture and lab structure by "flipping" the class. I placed lectures and instructional videos online and used class time for discussion and problem-solving. Evaluating students' perceptions of this approach revealed that they clearly found discussion groups helpful and preferred them to the traditional lectures used in other classes. Students did not have a clear preference between online versus in-class lectures. However, placing lectures online provided students with the opportunity to have discussion groups during regularly scheduled class time. Students generally felt that discussion groups helped them to understand the lectures, whereas the videos allowed them to use their time efficiently. Students reported that this course increased their knowledge of the targeted subject. In total, the flipped class approach appears to engage the millennial student in wildlife sciences in a format that accommodates their learning preferences. © 2015 The Wildlife Society.

KEY WORDS discussion groups, flipped class, survey, wildlife techniques.

The current cohort of "millennial generation" university students can often frustrate and challenge university instructors using traditional approaches to teaching and learning (Pardue and Morgan 2008). Born in the 1980s and 1990s, millennials have decreased patience for lecture-based classes (Roehl et al. 2013). Compared with earlier generations of students, they bore easily, expect variety, and desire interactive learning in the classroom (Roehling et al. 2010). As educators, it is important for us to teach in a manner that captures the attention of today's students (Roehl et al. 2013), while remembering the desires and tolerances of students have changed, not their abilities (Prensky 2010).

Millennial learners have a number of distinguishing characteristics that set them apart from other generations. These distinct characteristics are particularly evident in the way they learn and respond to different teaching styles. This generation has grown up online and is characterized by their near constant use of technology, which they expect to use in and out of the classroom (McGlynn 2005, Millenbah et al. 2011). Millennials also feel comfortable expressing their views and want discussions in the classroom (Krauss and Sear 2008, Taylor and Keeter 2010). This cohort prefers working on assignments and studying together in teams, and they prefer to engage with real-world issues in the classroom (McGlynn 2005, Krauss and Sear 2008, Millenbah et al. 2011). Compared with previous generations of university students, millennial students are nontraditional and often have competing demands on their time (e.g., work, child care, social activities) and thus prefer flexibility in their courses (Hanson et al. 2010, Yoshimura 2010). To meet the needs and learning styles of our current generation of students, it is critical that we teach in a manner that engages them (Kraus and Sears 2008).

In an effort to better accommodate millennials' learning preferences, I modified my wildlife techniques course structure by "flipping" the class. Wildlife Techniques is a foundational class, required in most, if not all, wildlife programs. The course is often centered on the latest version of the Wildlife Techniques Manual (Silvy 2012) and covers a vast array of topics, including study design, capture techniques, marking animals, radiotelemetry, and population estimation methods. The course has traditionally been taught in a lecture and lab format. Facts and theories were presented in lectures and labs were used for demonstration and hands-on application of the techniques presented in lectures.

I created a "flipped" version of the Wildlife Techniques course focused on engaging millennial students. This approach allowed me to address millennials' preferences for active learning, use of electronics, scheduling flexibility, working in groups, and engaging real-world problems in the classroom (Pardue and Morgan 2008, Roehl et al. 2013). When flipping the class, I placed all the lectures online to allow students more flexibility with their scheduling and interaction with technology. I then used class time for discussion sections to create an interactive teaching environment and to provide students an opportunity to collaboratively work on real-world problems. The course also included weekly labs, as well as 2 field trips, to provide the students with experiential learning opportunities. In an effort to provide additional flexibility, I used online

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instructional videos instead of in-class instruction to guide students through the analytical techniques they needed to complete their weekly lab assignments.

The purpose of this manuscript is to describe and critically evaluate the pedagogical techniques used in a flipped Wildlife Techniques course. Herein, I detail the format and implementation of the course, present results from a survey of students about the course, and discuss considerations for teachers interested in applying the flipped classroom format in wildlife courses.

STUDY AREA

This study was conducted at the University of Florida on the Gainesville campus, Florida, USA. The University of Florida is a Land Grant institution, with approximately 50,000 undergraduate students on its flagship Gainesville campus. All students in this study were in the Department of Wildlife Ecology and Conservation. Annually, there are approximately 200 undergraduate students in the department, all of whom are required to take the Wildlife Techniques course.

METHODS

Wildlife Techniques Course

Wildlife Techniques is a 4-credit semester-long course that is taught during both autumn and spring semesters to 25–30 junior and senior undergraduate students per semester. The expected learner outcomes for students in the course are as follows: 1) have the ability to design studies for sampling wildlife and vegetation; 2) be able to use maps, compasses, pacing, and Global Positioning System for orienteering and navigation; 3) know and use passive monitoring techniques in wildlife ecology; 4) know how to capture, handle, and mark birds, mammals, and herpetofauna; 5) know how to quantify vegetation communities used by wildlife; 6) understand the theory and methodologies for wildlife radiotelemetry; and, 7) be able to determine the best method for estimating the size of a population.

This study was conducted with students in the Spring 2012, Autumn 2012, and Spring 2013 sessions of the course. Students were assessed using weekly assignments (20%), written in-class exams (30%), a lab practical (10%), lab assignments and journals (18%), a group project (17%), and participation (5%). The course did not require Institutional Animal Care and Use Committee approval to handle animals; teaching activities using wild animals are exempt at the University of Florida.

Course Lectures

I recorded all my lectures as MPEG-4 (MP4) Part 14 formatted videos and placed them on the course website $\geq$1 week prior to our scheduled weekly class discussion sections. I created video lectures by recording my voice over a PowerPoint slide presentation using Camtasia software (TechSmith, Okemos, MI). There are a number of screen-capture software programs available, but I chose Camtasia because it allows one to easily incorporate audio or webcam images of the narrator into videos of the lecture. I made all of my video lectures shorter than 15 min to hold the students' attention (Green et al. 2013). For most weekly lectures I created 2 videos; but, for in-depth topics such as population estimation techniques, I needed 3 video presentations/week. Additional topics covered by online lectures included scientific writing, orienteering, study design, detection issues, occupancy modeling, passive capture methods, wildlife capture, marking wildlife, radiotelemetry, quantifying vegetation, and habitat selection.

Discussion Groups

I split the class into 2 sections of $\leq$16 students and we meet weekly for 50-min discussion groups. Prior to each discussion group I asked the students to watch the assigned lectures and complete readings from the peer-reviewed literature or the Wildlife Techniques Manual (Silvy 2012). To ensure that students were prepared for class, I assigned them 5 short-answer questions on the lectures and reading to be turned in prior to discussion group.

I used the first 10 min of discussion to highlight major points of emphasis from the lectures and readings, and to answer any questions raised by the students. For the remainder of class, I gave the students 2 or 3 problems to solve that required the use of information from the week's lectures and readings. To solve a problem, students broke into groups of 3 or 4 (small enough for students to get to know one another and feel comfortable (Roehling et al. 2010)), and worked on each of the problems for 3–6 min. During this time, I visited the small groups and helped them think through the solutions to their problem. Each smaller group then reported their solutions for the problem to the entire class. As a facilitator, I tried to have the class focus on the different approaches presented and to help them understand the advantages and disadvantages of each approach. When highly relevant or viable approaches were not touched on by the students, I would present them to the class and allow the students to evaluate them. Examples of problems presented in class included: What methods and study design would you use to determine the distribution of the endangered Florida bonneted bat (*Eumops floridanus*)? How would you permanently mark a marabou stork (*Leptoptilos crumeniferus*)? How would you estimate the number of squirrels (*Sciurus* sp.) on campus?

Course Labs

Each week, the entire Wildlife Techniques class met for a 5-hr lab. Lab instruction centered on experiential learning and using the techniques discussed in class. Most labs were structured as problem-based exercises that required the collection and analysis of data. For example, students worked on lab exercises to determine the occupancy of feral cats (*Felis catus*) on campus using trip cameras, to estimate the number of tree frogs (*Hyla* spp.) in a forest patch using mark and recapture, and to determine nest-site selection of squirrels. A critical component to these labs was learning the skills necessary to analyze the data. Instead of scheduling to bring the class to a computer lab to demonstrate the use of the software (i.e., Program Mark, Program Presence, Program Distance, Excel) needed to complete the assignments, I developed a series of instructional videos. Again, I used Camtasia software to create the videos that demonstrated the analysis needed to complete the assignment by working

through example data. The example data sets used were similar to the data that students collected in the lab.

Evaluation

To evaluate the pedagogical methods implemented in this course I used a voluntary survey to assess students' preferences and perceived learning outcomes. The survey was presented to students after the completion of each semester-long Wildlife Techniques course (Spring 2012, Autumn 2012, Spring 2013). The survey instrument and protocol was approved by the University of Florida's Institutional Review Board (no. 2011-u-1261).

The survey instrument consisted of 5 sections. Section 1 focused on student demographics and assessing students' familiarity with the flipped classroom approach. In Section 2, I used retrospective "post-then-pre" design to assess students' perceived knowledge of the course's expected learner outcomes by comparing it with their reflection of their knowledge prior to the class (Colosi and Dunifon 2006). This approach is convenient and reduces biases from exposure to pretests in a pre-and-post survey design (Davis 2003). However, this approach can be prone to recall bias (Hassan 2006) and measures perceptions of learner outcomes and not the actual knowledge gained by students. Students were asked to describe their level of agreement on a 5-point scale (1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, 5 = Strongly Agree) with 7 statements on their knowledge and understanding of the course's expected learner outcomes. The wording of the "post" part of the survey read, "Now that you have completed this course, please describe your level of agreement with each statement." Whereas the "pre" portion of this section read, "Thinking back before you were in this course, please describe your level of agreement with each statement."

The next 3 sections of the survey focused on the specific pedagogical methods used in class. Section 3 asked questions about students' preferences for web-based or traditional in-class lectures used in other courses. Section 4 covered students' comfort with and preferences for in-class discussion groups. Section 5 evaluated students' perceptions of the instructional videos used in lab. At the end of Sections 3–5, students were asked an open-ended question to share their thoughts on the use of the specific pedagogical method.

I evaluated student responses by reporting the number, percentage, and 95% confidence intervals of favorable (Agree and Strongly Agree) and unfavorable (Disagree, Strongly Disagree) responses. In cases where I evaluated a construct with 2 questions and Cronbach's α was >0.80 (Bland and Altman 1997), indicating strong consistency, I averaged the responses to the 2 questions. For questions where disagreement indicated support for the pedagogies presented, I inverted the results to aid interpretation. Finally, I reported responses to open-ended questions that captured the sentiments expressed in the survey.

RESULTS

Fifty-eight of 73 (79%) students taking wildlife techniques over the 3 semesters opted to take the survey. Thirty-three (57%) of the respondents were female; this was slightly <60% of females registered in the course over the 3 semesters. Less than half (39%) of the respondents had taken a class taught in a similar format to this one. Respondents were split in their preference for web-based (41%, 95% CI = 29–55) or traditional lectures (31%, 95% CI = 20–45), with a high proportion of respondents remaining uncertain of their preference (28%, 95% CI = 17–41; Table 1). Respondents who preferred the web-based lectures shared similar sentiments, commenting that the web-based lectures were "convenient and allowed you to re-watch them," "allows more time for lab and discussion," and "liked how short they were, kept my interest." Students who did not prefer web-based lectures offered comments indicating "it works for this class but I don't like courses that are completely on-line," "web-based lectures allow for procrastination and distractions," and "this is extra work that we should get credit for."

The majority of the respondents agreed or strongly agreed that they felt comfortable in discussion groups (76%, 95% CI = 65–87), that discussion groups helped them to understand lectures (95%, 95% CI = 85–99), and that discussion groups were preferable to traditional lectures (65%, 95% CI = 53–77; Table 1). Students who preferred discussion groups commented they "wished there was more time for discussion," and felt that the groups "allowed for independent thinking, discussion." Students also expressed that they "really enjoyed the solving of real life problems."

Table 1. Student agreement (5-point scale; Strongly Disagree to Strongly Agree) with statements about the efficacy of a flipped classroom design in the University of Florida's (Gainesville, FL, USA) Wildlife Techniques course from 3 semesters (Spring 2012, Autumn 2012, Spring 2013).

	Strongly disagree		Disagree		Uncertain		Agree		Strongly agree	
Course component	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Web-based lectures										
Prefer web-based to in-class lectures	5	9	13	22	16	28	11	19	13	22
Get more information from web lectures	6	10	13	22	17	29	11	19	11	19
Discussion groups										
Feel comfortable in discussion	2	3	4	7	8	14	18	31	26	45
Helped with understanding of lecture	0	0	0	0	3	5	20	34	35	60
Preferred to traditional lectures	1	2	6	10	13	22	24	41	14	24
Web-based lab videos										
Videos helped me complete assignments	0	0	1	2	2	3	13	22	42	72
Prefer videos to live instruction	5	9	10	17	27	46	11	19	5	9
Videos allow me to use time efficiently	1	2	3	5	12	21	11	19	31	53

Alternatively, the 24% of students that did not feel comfortable in discussion groups offered comments such as "I was timid to talk and didn't want to sound stupid" and "I don't like talking in class."

Most students agreed or strongly agreed that instructional videos allowed them to use their time efficiently and helped them complete their lab assignments (95%, 95% CI = 85–99). Nonetheless, only 28% (95% CI = 17–40) of respondents agreed or strongly agreed that they preferred videos to live instruction, whereas 26% (95% CI = 15–39) of respondents disagreed or strongly disagreed with this statement, and 46% (95% CI = 34–59) of respondents were uncertain. Comments from students who preferred the lab assignment videos included "they helped me slow down and effectively complete my work" and "they helped me save time and work at my own pace." Comments from those students who did not prefer the videos included "it would have been nice to ask questions" and "they allowed me to put off the assignment to the last minute."

Reflecting back on the class, most respondents reported increased knowledge of wildlife techniques during the class. The median response to all 7 expected learning outcomes increased from disagree or strongly disagree to agree and strongly agree (Table 2). Only 7 students reported that they did not perceive an increased competence in each of the 7 areas, and 3 of those respondents could not have perceived an increase because they indicated strong agreement with at least one of the learning outcomes prior to the course, making a positive change in perceived competence impossible.

DISCUSSION

The results of the survey suggested that students in this flipped wildlife techniques course favorably viewed the pedagogical approaches used in the class. From these results and informal student feedback at the end of each semester, it was clear that students enjoyed engaging with the course material during discussion groups. A number of students even indicated that they would like to expand the time allotted for discussion sections. This is consistent with research suggesting that millennials are often eager to express themselves in class (Krauss and Sear 2008, Taylor and Keeter 2010) and that discussions can simulate enthusiasm for a course (Roehling et al. 2010). Research also suggests that teaching content in highly specific contexts, such as the problems presented in this course, is associated with stronger student achievement and deeper conceptual understandings of the material (Darling-Hammond and Bransford 2005). Students in this techniques class believed they increased their knowledge of expected learning outcomes; however, our study design did not allow for an actual comparison of the flipped class approach to a more traditional lecture approach. Nonetheless, research directly comparing the 2 approaches generally finds that students in flipped classes outperform students in lecture-based classes (Herreid and Schiller 2013).

The greatest amount of effort in designing and executing my flipped Wildlife Techniques class was the creation of short online lectures and instruction videos. One week of lectures required 6–12 hr to develop, record, and edit. Instructional videos that accompanied labs required less time —about 4 hr/lab assignment. Once they were created, however, I spent less time preparing for class on a weekly basis. To keep the course current, I revised 3 or 4 weeks of lectures annually. I updated instructional videos more often (40% annually) to keep up with technological changes and software upgrades. The only additional monetary expense for the course was the purchase of the Camtasia software (TechSmith, Okemos, MI) at a cost of about US$300.

Some students preferred the in class lectures they were familiar with, commenting that they had trouble learning and staying engaged with online lectures and that it allowed them to procrastinate. Lecturing in the classroom would have pushed the course to $\geq$8 contact hours/week and would have likely competed with other demands on students' (e.g., work, child care, and social activities) and instructor's time (e.g., other instructional activities, research, service). Nonetheless, there are ways to increase engagement in online lectures. For example, some lecture-capture software (e.g., Articulate; Articulate Co. New York, NY) allows students to interact with video lectures by marking areas where they are confused and asking questions on the video timeline. Alternatively, providing questions or quizzes throughout online lecture can increase students' attention when watching online lectures (Schacter and Szpunar 2015).

Although some students expressed a desire to ask questions about their lab assignments in person, they chose not to do so when the opportunity was provided. I provided the students with the option of completing their lab assignments in a computer lab staffed with a teaching assistant. Students appeared to favor the flexibility associated with online instruction and rarely used the computer lab. Future ways to provide students with feedback and guidance for lab

Table 2. The median student responses (5-point scale; Strongly Disagree to Strongly Agree) with statements about their knowledge of the 7 learning objectives from before and after the University of Florida's (Gainesville, FL, USA) Wildlife Techniques course from 3 semesters (Spring 2012, Autumn 2012, Spring 2013).

Statement	Before course	After course
Can design studies for sampling wildlife and vegetation	Disagree	Agree
Use maps, a compass, and Global Positioning System in the field	Disagree	Strongly agree
Knowledge of passive detection methods for wildlife	Disagree	Strongly agree
Techniques to capture a variety of animals	Disagree	Strongly agree
Quantification of vegetation used by wildlife	Disagree	Agree
Theories and methods for wildlife radiotelemetry	Strongly disagree	Agree
Methods for estimating population size	Strongly disagree	Agree

assignments while still allowing flexibility in students' schedules may include having teaching assistants hold online office hours and having the instructor and teaching assistants respond to questions on course discussion boards.

The flipped classroom did pose some challenges to millennials in this study. A potential downfall to providing flexibility in the timing and place they completed their coursework is that it simultaneously provides opportunities for procrastination and requires that students use time management skills (Kerr et al. 2006). Time management challenges are not uncommon for millennials, who have been scheduled and supervised by adults for most of their lives and can at times lack the capacity to manage their own busy schedules (Pardue and Morgan 2008). Potential ways to address students' procrastination and time management issues include providing regular deadlines and feedback throughout the week and increasing the use of required study groups, chat rooms, and office hours (Tuckman 2007, Michinov et al. 2011, Green et al. 2013).

The freedom to work on assignments outside of a structured environment might also lead students to increased risk of plagiarism, which is a prevalent and well-documented academic issue for millennials (Evering and Moorman 2012). Students were explicitly told not to work together on assignments, but it was clear from a review of assignments and the plagiarism software used in the class that students were working on assignments together. One possible solution to this problem would be to restructure assignments to foster more collaborative working groups, as well as the exchange of students' ideas outside of the classroom (Evering and Moorman 2012). Other proactive steps to decrease plagiarism might include addressing expectations of original work and plagiarism at the beginning of a course, or to create assignments for a broader audience (e.g., videos, blogs, wikis, websites; Evering and Moorman 2012).

In conclusion, I provide several personal reflections for instructors considering flipping their Wildlife Techniques course. Do not be afraid to let students talk. When I first tried breaking students into groups, I was uncertain of how they would respond, but without fail they start enthusiastically discussing their solutions to the problems at hand. The challenging part of the discussion format is finding a balance between providing critical feedback to student comments and creating an environment where students are willing to share their ideas. I have found that the increased interactions with students facilitated by the flipped classroom improve relationships and simply makes teaching more enjoyable. Students respond to teacher enthusiasm, so I am continually developing different problems for the students to solve and to keep me excited and interested in the course material. Finally, creating online lectures is not a small task; but after the initial effort, I have found my preparation time for class has decreased and I find the teaching experience to be much more rewarding.

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