Student Achievement in an Equine Science Class: A Comparison of Lecture and Lab-based Outcomes

B. Adams-Pope[1]
University of Louisville
Louisville, KY

D. Duncan[2], K. Turner[3] and N. Fuhrman[4]
University of Georgia
Athens, GA

Abstract

The purpose of this study was to compare the effect of exposure to lab-based instruction to lecture-based instruction on student achievement as evidenced by test scores. Pre and post-tests were administered at the beginning and end of a 15-week long semester and student demographics, including previous experience with horses and horse ownership, were used to further examine the data. Both methods revealed increases in student test scores, but the lecture-based method showed a greater increase. The lab environment may have distracted the students and influenced the marginal growth in test scores for students participating in the labs. Students who owned horses may have already been familiar with the barn environment and been distracted (disengaged) with the information being shared in lab. The newness of the barn environment may have distracted non-horse owners from fully engaging with the content being shared in lab and resulted in little growth in test scores. These results suggest that equine labs may be more effective if separated into beginner and experienced sections. Additional research is needed to further understand this phenomenon.

Introduction

Aristotle once said, "For the things we have to learn before we can do them, we learn by doing them." Agricultural education (K-12 and college) has evolved over the past century and now integrates more methods of instruction than ever before (Newsome et al., 2005). Examples of pedagogical methods used in the agricultural sciences include the following: 1.Informal instruction - a conversation between student and teacher to acquire and distribute information; 2. Direct instruction - more formal and includes the lecture-based method of teaching often used with large lecture sections with typically little hands-on experiences for students; 3. Inquiry-based learning (critical thinking, problem-based learning, hands-on learning, and experiential learning) - adaptable and can be modified to students of all academic levels; 4. Cooperative learning - uses small groups to accomplish tasks; and 5. Information processing strategies - used to assist students in memorizing important facts and can include graphic organizers, mind maps, and story webs. With a cadre of pedagogical options available to teachers, selecting the most appropriate teaching method depends heavily on the educational situation (Doyle and Carter, 1987).

The experiential teaching method is one that is often referred to as hands-on or problem-based teaching. There is a common adage attached to experiential learning, "Tell me and I will forget, show me and I may remember, involve me and I will understand," (Confucius). David Kolb (1984), an educational theorist, stated that knowledge is gained through personal and environmental experiences. Most of the dimensions of experiential teaching are analysis, initiative, and immersion; while other forms of academic learning are focused on structure and reproductive learning (Ewing and Whittington, 2007). Experiential teaching is trying to create an experience for the student to learn from (Day et al., 1998). Understanding the environment where the experience is to occur and its potential novelty is crucial to ensuring that distractions are minimized and uninterrupted learning can occur. However, little is known about the influence of potential distractions in a non-classroom based learning environment and this lack of information prompted this study.

[1]Assistant Professor, Equine Industry, 502-852-7270, brittany.adamspope@louisville.edu
[2]Professor, dwd@uga.edu
[3]Associate Professor, kturner@uga.edu
[4]Associate Professor, fuhrman@uga.edu

Theoretical Framework

The theory base for this study was constructed around David Kolb's (1984) work with experiential learning. The first stage, *concrete experience* (CE), is where the learner actively experiences an activity such as a lab session or field work. The second stage, *reflective observation* (RO), is when the learner consciously reflects back on that experience. The third stage, *abstract conceptualization* (AC), is where the learner attempts to conceptualize a theory or model of what is observed. The fourth stage, *active experimentation* (AE), is where the learner is trying to plan how to test a model or theory or plan for a forthcoming experience (Kolb, 1984. p. 38). However, the model does not reflect the novelty of the learning environment and associated potential distractions which could influence learning outcomes.

Previous research has shown that the teaching method used can influence student achievement (Day et al., 1998; Newsome et al., 2005; Wulff-Risner and Stewart, 1997). Instructional theory suggests that creating a diverse instructional system will promote learning, but could the learning environment be so diverse that it limits student achievement? An early study by Borzak (1981) found that active experimentations allow students to take an active role in their learning; therefore "owning" their knowledge. This ownership happened more with the experiments than with the knowledge learned in lecture classes. With this increase in knowledge, it is assumed, there will be an increase in achievement. However, there have been studies (Brown, 1998; Burris, 2005) showing that students instructed using the problem-based approach during lecture classes also increase knowledge, subsequently increasing achievement (Sundblad et al., 2002). Studies have also found that when students are physically connected with material and more physically active in the classroom, they will retain more information (Burris, 2005; Hancock and Wingert, 1996). Can this "classroom" include a barn-based lab environment? There has been limited research studying the impact of lab-based environments on achievement. Results from a study done to measure the effect of previous equine experience on performance in an introductory level equine science class showed that previous experience had no impact on final grade; although, students with previous equine experience did not appear to have to work as hard to achieve the same grades (Pratt-Phillips and Schmitt, 2010). Additional information is needed to determine whether the learning environment can influence student achievement.

The purpose of this study was to compare the effect of exposure to lab-based instruction to lecture-based instruction on student achievement in an upper level equine management course at a land-grant university. The objectives and methodology are described below.

Objectives

The objectives of this study were the following:

1. Determine the effects of the experiential teaching method (barn-based lab) on students' achievement rates in an undergraduate equine management course;
2. Determine the effects of a lecture-based teaching method on students' achievement rate in an undergraduate equine management course; and
3. Determine if specific student demographic characteristics influence student achievement for either teaching method.

Methodology

This study was a comparison of the experiential (lab-based) and lecture-based teaching methods as related to student achievement on identical pre- and post-tests. A quasi-experimental, one group comparison design was established using pre and post-test results for an undergraduate equine management course at the University of Georgia. Additionally, demographic information, including previous horse experience and horse ownership, of the student participants, was collected. The experiential teaching method consisted of a hands-on laboratory style teaching environment where students participated in various activities with horses in a barn environment for approximately three hours per week during a fifteen-week semester. The students spent the first twenty minutes of the lab session in a classroom setting discussing the topic of the day and addressing any concerns associated with the lab work. The lecture-based teaching environment was strictly professor led and consisted of using PowerPoint slides and non-participatory teaching methods. The information discussed in the lab sections was previously discussed in the lecture section. Both the lab and lecture sections were taught by the same instructor to control for the potential influence of teaching style on learning outcomes. Twenty-one upper-level undergraduate students participated in both the lecture and lab sessions.

Data was collected during the first and last day of the semester, with approximately fifteen weeks between data collection for both teaching environments. The two-part survey instrument was designed to measure student achievement concerning knowledge of equine science and care, and collect demographic data. The professor in charge of the course designed the instrument to ensure that the questions were appropriate and effective in measuring student knowledge and comprehension. Additionally, questions were designed to reflect the nature of the content presented in the lecture and laboratory sections and build content validity of the instruments Having a pre-test safeguarded the threat of prior knowledge from affecting the outcome of the study and provided baseline data for comparison. The researcher scored all tests using an answer key, provided by the course instructor, to eliminate the threat of scorer variability as items were both quantitative and qualitative in nature.

Descriptive statistics, including frequencies, means, and standard deviations, and paired samples *t*-tests were calculated using the Statistical Package for the Social Sciences (SPSS) Version 18.0. Pre and post-test summated scores were created and growth scores (comparing post and pre scores) were calculated to determine the amount of change in students between pre and post measurements. Participant demographics, including whether they owned a horse, had taken previous equine science courses, and self-reported prior horse knowledge, were used as contextual variables to further compare scores.

Results and Discussion

Objectives 1 and 2: Determine the effects of the experiential and lecture-based teaching methods on students' achievement in an equine science course.

The researcher used a paired samples t-test to analyze the lab data and test for significant differences between pre- and post-test means. Both the lab-based (t = -6.67; df = 20; p = 0.000) and lecture-based learning environments (t = -12.08; df = 20; p = 0.000) produced statistically significant gains in knowledge scores at the 0.05 level (see Table 1). Specifically, on all but one question, student test scores on the pre-test and post-test increased. However, the lecture-based instruction produced larger gains in test scores between the pre- and post-test (average gain following laboratory-based instruction = 7.25; average gain following lecture-based instruction = 12).

Table 1. Changes in Test Scores Following Exposure to Either Laboratory-based or Lecture-based Instruction (n = 21 students)

Laboratory-based Instruction			Lecture-based Instruction		
Question	Pre-test Correct f (%)	Post-test Correct f (%)	Question	Pre-test Correct f (%)	Post-test Correct f (%)
1	7 (33.3)	12 (57.1)	1	10 (47.6)	20 (95.2)
2	1 (4.8)	11 (52.4)	2	2 (9.5)	16 (76.2)
3	2 (9.5)	19 (90.5)	3	6 (28.6)	17 (81.0)
4	10 (47.6)	13 (61.9)	4	11 (52.4)	20 (95.2)
5	6 (28.6)	19 (90.5)	5	3 (14.3)	19 (90.5)
6	1 (4.8)	2 (9.5)	6	0 (0)	7 (33.3)
7	13 (61.9)	13 (61.9)	7	3 (14.3)	20 (95.2)
8	3 (14.3)	12 (57.1)	--	--	--

Note. The laboratory test contained eight questions and the lecture test contained seven questions, each worth one point.

Table 2. Comparison of Lecture-based and Laboratory-based Instruction Methods for Students Who Owned Horses

Instruction Method	Mean (SD)	t-value	P-value	Effect Size
Lecture-based Pre-Score	1.70 (1.42)	-7.13	< 0.0001	Large
Lecture-based Post-Score	5.60 (1.26)			
Laboratory-based Pre-Score	2.70 (1.34)	-3.04	0.014	Large
Laboratory-based Post-Score	4.50 (1.43)			

Note. The maximum possible score on the laboratory test was 8 points and the maximum possible score on the lecture test was 7 points.

The lecture-based teaching environment showed more of an increase in student achievement than the lab section and student post-test scores were higher for the lecture-based teaching environment than the lab section. Comparing growth scores and post-test scores for the lab and lecture sections resulted in statistically significant differences (t = -2.81, P = 0.011, effect size = large). A cadre of researchers have concluded that experiential teaching methods can have an impact on student achievement in comparison to the standard lecture-based classroom (Burris, 2005; Hancock and Wingert, 1996). Results of this study are contradictory to the aforementioned belief. Even though students improved academically with both types of instruction, their achievement rates were higher for the lecture-based instruction.

There may be a few reasons why the experiential learning showed less of an increase in achievement. One reason may be a "distractor factor." When students are in an outdoor (barn) environment with live animals there are many more things to look at and pay attention to than just the instructor. In the large group setting (21 students) it was easy for students in the back of the group to talk to each other without the instructor noticing. The weather may have played a part in the "distractor factor" as students may lose focus if they are too hot or cold. Drozdenko et al. (2012) found students talking in class, and temperature (too hot/cold) to be in the top three out of 36 distractions for a classroom. Outdoor humidity has been shown to have a positive effect on emotions such as frustration and sadness while solar radiation has a negative effect on sadness (Ciucci et al., 2011). Note taking in a laboratory section was also decreased, compared to a lecture, as most of the activities were hands-on and students were primarily standing in a barn, arena, or pasture and had nothing to write on such as a desk. Also, the topics addressed in the lab sections were previously touched on in the lecture section, this may have led to the increased lecture scores because students were having lecture material reinforced by the lab sections. Finally, the lecture-based instruction may have increased scores more due to the instructional methods of the instructor. The instructor asked a lot of questions during lecture and strongly encouraged students to be active learners and participate in the class. Due to laboratory activities there were fewer questions asked during labs. Critical thinking is a large component of any classroom, including it in lecture may increase achievement by making students think on their own while learning through lecture (Richardson, 2003). Understanding what is being taught instead of just possessing the knowledge will increase achievement with any teaching method.

Objective 3: Determine if specific demographic characteristics influence student achievement for either teaching method.

Nine participants (43%) reported owning horses. Horse ownership played a role in the rate of achievement for the experiential (lab) teaching environment (see Table 2). Horse owners' experienced larger gains in test scores from lecture-based instruction compared to laboratory-based instruction (see Table 2). Although not shown, non-horse owners' post-test mean scores for both lab and lecture were higher in comparison to participants who owned a horse(s). This could be attributed to horse owners relying on prior knowledge, and not taking as many notes or studying as hard as non-horse owners.

Table 3. Comparison of Lecture-based and Laboratory-based Instruction Methods for Students with No Previous Equine Course Exposure

Instruction Method	Mean (SD)	t-value	P-value	Effect Size
Lecture-based Pre-Score	0.83 (0.41)	-13.69	< 0.0001	Large
Lecture-based Post-Score	5.83 (0.75)			
Laboratory-based Pre-Score	1.67 (1.63)	-2.37	0.064	Large
Laboratory-based Post-Score	4.17 (1.83)			

Note. The maximum possible score on the laboratory test was 8 points and the maximum possible score on the lecture test was 7 points.

Table 4. Comparison of Lecture-based and Laboratory-based Instruction Methods for Students with No Prior Experience with Horses Through Extracurricular Activities

Instruction Method	Mean (SD)	t-value	P-value	Effect Size
Lecture-based Pre-Score	1.22 (0.44)	-9.73	< 0.0001	Large
Lecture-based Post-Score	5.44 (1.33)			
Laboratory-based Pre-Score	1.33 (1.00)	-7.49	< 0.0001	Large
Laboratory-based Post-Score	4.89 (1.17)			

Note. The maximum possible score on the laboratory test was 8 points and the maximum possible score on the lecture test was 7 points.

The influence of prior equine class participation on student achievement was also examined. Fifteen students reported previously taking an equine science class. Examples of classes included, but were not limited to: Pleasure Horse Management, and Equine Nutrition and Exercise Physiology. Participants who reported no previous equine course exposure exhibited a substantial increase in rate of achievement following exposure to lecture-based instruction when compared to laboratory-based instruction (see Table 3). The reasons for this are probably similar to, if not the same as, the reasons given for Objectives 1 and 2.

Finally, the influence of prior experience with horses through extracurricular activities on student achievement was examined. Again, students reporting no prior experience with horses through extracurricular activities showed higher and statistically significant gains in scores following lecture-based instruction compared to laboratory-based instruction (see Table 4).

Summary/Implications

The purpose of this research was to determine the impact on student achievement following exposure to a fifteen-week lab (experiential learning experience) and fifteen-week lecture-based instruction. As evidenced in Table 1, students increased their performance during their fifteen weeks of instruction for both lecture and experiential based learning environments. Students with no prior horse experience, either through horse ownership or equine course attendance, had higher increases in achievement in lecture-based instruction (compared to laboratory-based) as well as greater increases than students with prior equine experience or class attendance.

The greater increase in achievement for the lecture-based instruction was possibly due to a “distractor factor”. Taking this into consideration, having a very structured lab setting may have a positive effect on the increased rate of achievement. The instructor may choose to break students of comparable ability into smaller groups to lower the risk of distractions or having student with more prior knowledge lead a discussion for a smaller group. The instructor may also want to spend more time away from the live animals and distractions by having an indoor classroom to meet in before and after to go over expectations and reflect on what the students should have learned. Environmental factors may be reduced by using areas such as an indoor arena, or closing barn doors. The instructor should also strongly encourage the students to bring clipboards and take extensive notes during a laboratory session. Having a study to show different types of lab settings, some more controlled than others, would be ideal.

Future research should increase the sample size and the longevity of the study. The results in every objective were statistically significant with small standard deviations. This leads one to believe that a larger sample size will just solidify more what was found in this study. There should also be a control group used to establish a baseline for knowledge prior to instruction. Having different types of lecture such as multiple instructors or guest speakers, having a more varied sample (ethnicity, SES, etc), and lecture setting may result in different outcomes. Also, when giving pre-tests, the teacher can never be completely positive that he/she will cover everything that was tested. With this in mind, the instruments used to test the rates of achievement could be more structured in the future (i.e. making sure that everything tested was covered with same emphasis on each item).

Finally, something also worth noting is that there were eight lab related questions and seven lecture related questions on the pre and post-test. Re-analyzing the data and deleting one question from the lab questions may yield different results as far as the significance, means, and frequencies. Going back and checking for questions missed frequently and confirming that everything on the tests was covered in class is a necessity also. Using different instruments to test for achievement may also help. A future study could combine problem-based learning, critical thinking, and reflection to see if different results are found. Combining as many proven teaching methods as possible may give teachers more resources to pull from if they see one thing is not working for a class.

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