Does Experiential Learning Improve Student Performance in an Introductory Animal Science Course?

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Abstract

At postsecondary educational institutions, the learning process has lecture at the focal point of most courses, for-going experience, and hands-on learning for the more efficient lecture-based model of teaching. A consensus exists among educators that motivation and student engagement can be difficult but remain a crucial part of planning and teaching. Hands-on experiences can be used to motivate students and allow them to gain problem-solving and critical-thinking skills. Therefore, the purpose of this study was to investigate the influence experiential learning had on students enrolled in a large lecture introductory animal science course at the University of Georgia. This quasi-experimental study divided the students enrolled in the course into two groups to determine if experiential learning had a positive influence on the students learning. The experiential learning activities were designed to replace a two-hour study session held each week during the semester. Student performance was measured by the scores on the course summative assessments. The first quiz scores were analyzed by group to determine if a difference was found between the groups. There was no significant difference ($p = 0.60$) found between the two groups on the first quiz. The researchers found that no significant differences were found between the groups of students on questions related to the four content areas. Therefore, the researchers concluded that experiential learning may not have a positive impact on all learning experiences for students. Therefore, more research should examine the utilization of experiential learning in the teaching of introductory content material to college students.

Introduction and Review of Literature

Kolb explained learning as, "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p. 41). Within postsecondary educational institutions, lecture is frequently utilized to foster and facilitate learning in the classroom, indicating the lack of direct experience and hands-on learning in favor of the more efficient lecture-based model of teaching. Further, removing experience-based learning leaves a gap in the development of underclass students at a postsecondary level. According to Kolb (1984), a gain in knowledge is the result of transforming information learned from an experience, implying that learning cannot occur through presentation alone; transformation of experience with the material is required for true knowledge acquisition. Healey and Jenkins (2007) implemented experiential learning in geography in higher education. In their article, the authors outlined the strengths that Kolb's conceptual frame has for postsecondary institutions. Among the strengths was the benefit of implementing experiential learning into an entire degree program but starting with one course or class session can be equally beneficial for students (Healey & Jenkins, 2007). Students come to a classroom with different learning styles and adaptive natures, but Mainemelis et al (2002) notate that both internal factors (e.g., learning styles) and external factors lead to the acquisition of knowledge and formation of intelligence. Mainemelis et al (2002) also postulated that "intelligence is thus the result of the dialectic integration of internal cognitive organization, reflective abstraction, and external adaptation, active involvement in experience" (p. 7). John Dewey (1938) was the first academic to connect education with experience but warns against the concept that not all experiences are education, which was later explained by Kolb (1984) in his experiential learning model. Dewey (1938) acknowledges that students already have experiences in classrooms, but those experiences lack the depth and character to be learning experiences. To better understand the learning experiences of students in a lecture-based college introduction to animal science course, researchers sought to examine the impact that the integration of experiential learning lessons have on student comprehension of basic animal science topics in comparison to traditional lecture.

A consensus exists among educators that motivation and student engagement can be difficult but remain a crucial part of lesson planning and teaching. Hands-on experiences can be used to motivate students, leading to a gain in problem-solving and critical thinking skills, often acquired through experiential learning activities (Rhykerd et al., 2006), as well as improving student achievement (Stor-Hunt, 1996), the necessary skills to succeed (Barron et al., 2017), and attitudes towards learning (Johnson et al., 1997). In examining how experiential learning can be used to motivate students and the development of problem-solving skills, Rhykerd et al (2006) implemented a hands-on contest with crop production and marketing to help students without an agriculture background gain real-life experience that they can apply to their future careers. The researchers created the contest based on pedagogical research centered around the idea that comprehension can be increased through activities applying real-world situations and critical thinking concepts (Rhykerd et al., 2006). Upon analysis, researchers noted these activities and exercises led to a positive impact on student knowledge development (Rhykerd et al., 2006). Furthermore, in examining the impact of hands-on experiences on student achievement in a middle school science course, Stor-Hunt (1996) determined that students involved in hands-on activities more frequently scored relatively higher on science exams. Additionally, not only does the integration of experiential learning impact student achievement and knowledge development, but these experiences also improve student confidence and self-efficacy (Barron et al., 2017). Veterinary students undergoing their final year of coursework were exposed to real-life appointments, in which they were required to discuss diagnosis and treatment with clients. Researchers concluded a significant increase in confidence and communication skills through the integration of these experiences (Barron et al., 2017). As mentioned, prior research indicated that the integration of hands-on learning also improved student attitudes toward learning. Johnson et al. (1997) concluded that including hands-on learning activities in the classroom was effective in developing positive student attitudes toward academic subjects, and increasing these activities can influence student outcomes in agricultural and science education.

While hands-on experiences are often utilized more frequently in laboratory experiences, circumstances exist in which hands-on, experience-based lessons are removed from courses and replaced with more lecture-based instruction. Therefore, it is important to re-evaluate the use and efficacy of experiential learning in comparison to traditional lecture-based instruction. Furthermore, within agricultural education, the importance of integrating experiential learning opportunities for students is ever important. Osborne (1993) elaborated on the distinct change toward science-based methods in agricultural education through agriscience. He stressed the importance of the incorporation of science into the agriculture industry. Osborne (1993) stated, "our job is not to duplicate science instruction offered by science departments. Our job is to teach science differently, focusing on applications of science in all facets of the broad agricultural industry" (p. 3). A shift towards agriscience and using scientific methods and principles in agriculture education requires a focus on active learning through hands-on activities. Additionally, Shoulders and Myers (2013) concluded that guiding students through experiential learning can enhance their learning in lab settings, increase science literacy, and lead to higher-level thinking, even though laboratory settings have been previously associated with only the development of psychomotor skills. However, Shoulders and Myers (2013) determined that most educators were not engaging their students in experiential learning, leading to a lack of development and acquisition of relevant knowledge. Further research within agricultural education and experiential learning indicated that students who had the experiential learning treatment scored higher on domain-specific creativity and practical use of knowledge, but students who did and did not receive the treatment scored similar on analytical knowledge (Baker & Robinson, 2016). Based on the results, Baker and Robinson (2016) suggested incorporating experiential learning and traditional lecture-based instruction, stating, "combination produces successful student intelligence most effectively" (p. 139). Baker and Robinson (2017) continued their research in an experiential learning approach in an agriculture classroom regarding student motivation, to which the researchers determined that instruction type does not alter student motivation and learning style plays a role in motivation. In the recommendations, the researchers re-emphasized the need for varied instruction to reach students in all learning styles, as well as adequate planning and delivery (Baker & Robinson, 2017).

Although research has indicated the use of experiential learning is important for student development and the acquisition of skills and competencies to be successful, a lack of research examining the integration of experiential learning in college agricultural and animal science courses is limited. A level of accountability existed in incorporating experiential learning into college-level courses (Caulfield & Woods, 2013). Studies have shown positive outcomes of experiential learning through internships (Esters & Retallick, 2013), study abroad (Ingraham & Peterson, 2004), and work-study programs (Ambrose & Poklop, 2015). However, few exist surrounding the implementation of experiential lessons into large, introductory science courses in a university setting. Healy and Jenkins (2000) recommended that research in geography education should examine whether post-secondary students in the twenty-first century identify as having a predominant learning style in the incorporation of experiential learning in a university setting. Additionally, Coker et al. (2017) suggested examining the impact of experiential learning in situations where students are randomly assigned to groups of varying information, as an attempt to eliminate any biases of self-selection, student demographics, and other common traits and characteristics. Therefore, this study aimed to bridge the gap in the literature by integrating experiential education lessons into a large introductory animal science course and examining the impacts on student academic achievement on course tests following the experiential education lesson.

Conceptual Framework

This study was guided by the conceptual framework of experiential learning theory as defined by Kolb (1984), and further elaborated upon by Kolb and Kolb (2005). The process of experiential learning has a perspective that "emphasizes the central role that experience plays in the learning process" (Kolb, 1984, p. 20). Experiential learning is used to solidify the learning experience through four stages as seen in Figure 1: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). True learning occurs when individuals have the chance to both the experience, as well as the reflection and transformation of the knowledge (Kolb, 1984). Furthermore, Kolb and Kolb (2005) clarify that experiential learning is not a technique taught to students or a mindless reflection on experience, but rather a philosophy of education. The transformation can be seen in classrooms when students are tested on the knowledge created in experiences. Experiences can be created in classrooms through hands-on activities that are coupled with other teaching methods to help students with varied learning styles. To further explain the factors within experiential learning, Kolb (1984) outlines six characteristics of experiential learning. Learning is:

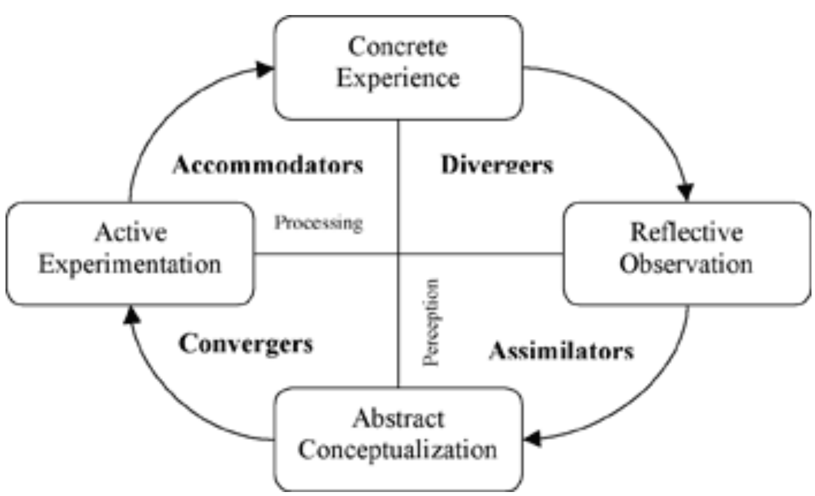
1. Described best as a process, not an outcome
2. Continuously grounded in experience
3. Requires the resolution of internal conflicts with external stimuli
4. A process of adapting to external stimuli
5. Interactions between the person and the environment
6. The process of creating knowledge

Two characteristics of Kolb and Kolb's (2005) description of the Experiential Learning

Theory are significant for this study, the facets that learning is conceived by the process of creating knowledge and learning results from interactions between the person and their environment. Additionally, Kolb (1984) posits that learning is best described by the process of creating knowledge and is a continuous process grounded in the experiences of the learner. Kolb (1984) states, "the emphasis on the process of learning as opposed to the behavioral outcomes distinguishes experiential learning from the idealist approaches of traditional education" (p. 26). In examining the application of experiential learning theory in collegiate-level courses, Healey and Jenkins (2007) applaud the theory for being easy to well-developed, and understandable and for its generalizability over single classes or entire degree programs. Additionally, agriculture classrooms and laboratories have used experiential learning as a foundational component for numerous years, as educators have continually utilized varied aspects of the theory and many of the applications to educate students.

Figure 1

Kolb's (1984) Experiential Learning Model



Purpose and Objectives

The purpose of this study was to investigate the influence experiential learning had on students enrolled in a large lecture introductory animal science course at the University of Georgia. The National Research Agenda called for research to investigate learning to ensure that graduates are prepared for the 21st-century workforce (Roberts et al., 2016). This study was guided by the following research objective and hypothesis:

- Describe the effect of experiential learning activities on student comprehension of content taught in an introductory animal science course.
- H_o: Students who participated in experiential learning activities will have an equal mean score on the course summative assessments compared to those who did not participate in the experiential learning activities.
- H_α: Students who participated in experiential learning activities will have a higher mean score on the course summative assessments compared to those who did not participate in experiential learning activities.

Methods and Procedures

This study was conducted utilizing a quasi-experimental design to ensure that all students in the course were granted the same opportunities and to reduce any effects from this population not being randomized (Campbell & Stanley, 1963). According to Campbell and Stanley (1963), quasi-experimental design studies should utilize a crossover method to ensure that multiple data points are collected from each student in the population. Therefore, the researchers broke the course into four sections and alternated the utilization of experiential learning activities for each of the two groups (Table 1).

Table 1

Experimental Treatments by Group

Content Area	Group	Treatment
Reproduction	A	Experiential
	B	Control
Nutrition	A	Control
	B	Experiential
Genetics	A	Experiential
	B	Control
Meats	A	Control
	B	Experiential

Course Description

Within the Department of Animal and Dairy Science at the University of Georgia, all students are required to complete an introductory animal science course. However, the laboratory component of the Introductory to Animal Science course was removed from the course nine years ago to help alleviate teaching overloads and budgetary constraints. Therefore, the introductory animal science course has been taught as a standalone lecture-based course, structured to teach the basic animal science material all students need to comprehend before taking more advanced courses. The faculty who have taught the course have extensive experience in teaching laboratory classes and have attempted to enhance their classroom instruction in this course to provide students with a better learning environment. The class meets three times a week for a 50-minute lecture and students were offered a once-a-week study session that could last up to two hours.

Study Design

To ensure variability among the two groups, students were randomly assigned to one of the two groups, denoted as either A or B. Group assignment was determined during the beginning of the semester, prior to any instruction of course material. Thus, one experimental treatment was designed for this study, where students were either in a control group or an experiential learning group for each of the content areas. The group that received experiential learning lessons were taught utilizing hands-on lessons twice during the unit. The laboratory activities were designed through the lens of Kolb's experiential learning model, in which the labs were structured to ensure students were given the opportunity to engage in each stage of the model. Students were provided with varied hands-on activities and review sections during the session, which was scheduled during the specified time block for traditional review. Each of the activities were planned to take 105-minutes, to ensure that there was time for questions and further explanation for students without exceeding the 120-minute class period. Activities were taught by faculty in the Department of Animal and Dairy Science alongside faculty from the Department of Agricultural Leadership, Education and Communication, with assistance from the teaching assistants for the course, to ensure that students received instruction in a consistent format for fidelity of experimental treatment. Researchers and faculty developed each laboratory activity to correlate with what was being taught in lecture and would be included on the summative assessments. Activities included the deconstruction of a hog carcass in meat science, the dissection and labeling of male and female reproductive tracts in the reproduction unit, examining breed outcomes of puppies and mice during the genetics unit, and the dissection and evaluation of microbial presence in monogastric and ruminant tracts during the digestion unit. In each lab, students were provided the opportunity to first observe each activity demonstrated by the instructors, upon which they then were able to ask questions and build upon what was learned in the lecture. Students were then able to complete the activity in groups, applying the concepts of what was learned in lecture and the demonstration to their own experience and experimentation, completing the cycle of experiential learning. Instructors provided assistance to students throughout the lab as needed, allowing for the opportunity to develop an understanding of the content and apply what was learned to their experiment.

The traditional review session also took place during the 120-minute period, considered to be the control group, in which the students met with the course teaching assistants to review content during a study session. This review was led by student questions to create buy-in from the students attending. To ensure that students were attending the correct session and for fidelity in the treatments, attendance was taken during each meeting to verify the group assignment and ensure that upon data analysis, student grades were sorted appropriately. If, for any circumstance, students missed an experimental treatment, they were removed from the study. Additionally, students were provided the opportunity to remove themselves from the study altogether, and these students were continually offered the opportunity to attend the traditional review session.

Data Collection and Analysis

Data were collected through four summative course assessments given throughout the semester during specified exam hours, and a final summative exam given at the conclusion of the semester. Exams were created by faculty in the animal science department and were examined prior to each exam to ensure that content was relative to the experiential learning lessons and review sessions that were taught throughout the semester. The exams were also designed to be in correlation with the objectives of the overall course, which were written according to the understand classification within Blooms Taxonomy rather than the analyze or evaluate classifications (Krathwohl, 2002). The exams and objectives were designed in this way to ensure that students in an introductory course were provided with the opportunity to develop the knowledge and skills necessary to complete advanced classes in their major. The summative assessments were given during designated test sessions that were either two hours in length for a unit exam or three hours in length for the final exam. All assessments presented to students were identical in design and students were asked to indicate whether they were in Group A or B prior to completing the exam. This was done to ensure that there were no external influences on student performance or data analysis. Assessments included a variety of multiple choice, true/false, and short answer questions directly related to the content that was taught during the lecture-based component of the course.

Upon completion of the exams, scores were tabulated and sorted by student and group. Content experts and researchers reviewed each exam for total exam score, as well as the total number of questions that were deemed correct and directly related to what was taught in the course and later reviewed or expanded upon with experiential learning lessons. The total number of content related scores that were deemed correct ranged from 10 to 65 questions, depending on the additional content that was taught during the course, which was anywhere from the additional 90 questions to 35 questions. For the final exam, researchers and content experts separated the exam into content areas, which included 16 nutrition questions, 18 reproduction questions, 16 genetics questions, and 11 meat science questions. After scores were tabulated and entered into spreadsheets, data were then analyzed using SPSS version 25 with an *a priori* level of .05.

Results

Prior to the study, quiz scores from the first quiz given in the course were analyzed by group to determine if a difference was found between the groups. There was no significant difference (p = 0.60) found between the two groups on the first quiz. Additionally, as previously stated, due to this being an introductory course, students entered the course with either no prior knowledge or limited knowledge from high school curricula. Therefore, because the quiz scores were determined to have no significant difference, the groups were deemed similar and the study groups were deemed appropriate for this study.

After completion of each exam, and tabulation of scores, researchers examined mean scores for each of the content areas within the summative assessments. Mean scores between the groups varied in regard to the difference between the scores, with the largest difference being between the groups within the reproduction content area. The mean score of the treatment group was

40.33 (*SD* = 4.21) and the mean score for the control group was 39.33 (*SD* = 3.55). Table 2 displays the mean scores for content area based upon group assignments.

Table 2

Student Assessments Mean and Standard Deviations for Each Content Area

Content Area	Group	n	Mean *(SD)*
Reproduction	Experiential	39	40.33 *(4.21)*
	Control	42	39.33 *(3.55)*
Nutrition	Experiential	42	42.43 *(4.46)*
	Control	39	43.13 *(4.62)*
Genetics	Experiential	39	37.77 *(3.67)*
	Control	42	37.17 *(3.99)*
Meats	Experiential	42	13.52 *(2.71)*
	Control	39	14.05 *(2.84)*

To further examine the data, an independent sample t-test was run to determine if significant differences existed between the control and experimental groups for each content area. The independent samples t-test showed that no significant differences existed between the control and experimental groups on the four content questions. Further examination was conducted at the question level and found that only four total questions were found to have a significant difference at the .05 level. Table 3 displays the results of the independent samples t-test for each content area.

Table 3

Independent Samples t-test – Mean Scores on Each Content Area Between Groups

Content Area	*F*	*t*	*df*	*p*
Reproduction	.71	1.15	74.59	.25
Nutrition	.13	.69	78.05	.49
Genetics	.08	.71	78.99	.48
Meats	.41	.86	77.84	.40

Upon completion of individual summative assessment analysis, researchers then examined final exam scores. Exam questions were divided into each content area, and then mean questions correct and standard deviation were calculated per group (Table 4).

Table 4

Mean Questions Correct and Standard Deviation for Final Exam

Content Area	Group	n	Mean *(SD)*
Reproduction	Experiential (A)	39	12.67 *(3.35)*
	Control (B)	42	12.74 *(3.12)*
Nutrition	Experiential (B)	42	12.12 *(2.33)*
	Control (A)	39	12.05 *(2.53)*
Genetics	Experiential (A)	39	12.82 *(1.67)*
	Control (B)	42	12.28 *(2.08)*
Meats	Experiential (B)	42	8.48 *(2.71)*
	Control (A)	39	7.95 *(2.84)*

After examining the overall mean and standard deviation per group by content specific questions deemed correct on the final exam, researchers then analyzed the data, using an independent samples t-test. This was done to determine if there were any significant differences between the two groups, in which the results of this analysis revealed there was no significant differences within any content area (Table 5).

Table 5

Independent Samples t-test – Mean Scores on Each Content Area Between Groups

Content Area	*F*	*t*	*df*	*p*
Reproduction	.002	.09	79	.46
Nutrition	.040	.13	79	.45
Genetics	1.08	1.27	79	.10
Meats	.410	.86	79	.19

Conclusions

Based on the results of the study, the researchers fail to reject the null hypothesis, as there were no statistically significant differences in assessment scores between the group that received experiential learning activities in the laboratory session and the group that did not. Although the researchers determined there were no statistically significant differences in the teaching methods used for the lecture and review group, and the lecture and experimental group, the nature of the course was to create a baseline of knowledge for students to continue in their degree program where further experiential learning activities were used more frequently.

As noted, faculty within the animal science department at the University of Georgia designed the overall course utilizing lower levels of Bloom's Taxonomy (Krathwohl, 2002), utilizing lecture-based instruction to provide students with the opportunity to develop the knowledge and skills to be successful in more complex courses in students' program of study. However, within the implementation of this study, researchers and faculty integrated hands-on experiential components in the overall design of the course, to provide students the opportunity to develop knowledge at the analysis and evaluation classification (Krathwohl, 2002). While the researchers sought to determine whether or not experiential learning impacted student performance and success (Barron et al., 2017; Stor-Hunt, 1996), the development of skills and knowledge (Rhykerd et al., 2006), and attitudes towards learning animal science content (Johnson et al., 1997), researchers determined that the experiential learning sessions were not implemented appropriately. Because of this, the discrepancies between the exam questions and the knowledge presented in the laboratory sessions should be noted for future studies and additional implementation of experiential learning in an introductory animal science course.

Among the students in the course, whether participation occurred in laboratory sessions or the traditional review session, there was no statistically significant difference in knowledge comprehension between the control and experimental groups. However, there was evidence that a few individual questions may reflect a benefit in hands-on experiences for some content areas, as the results from the nutrition, genetics, and meat science assessments revealed a higher average of questions correct from these activities. Additionally, it is evident that some experiential learning activities provide students with the opportunity to develop more content related knowledge and improve scores on summative assessments. Although researchers noted an increase in student assessment scores, it can be concluded that in this study, experiential learning does not always impact student success and knowledge gain.

Experiential learning is a beneficial teaching method that uses hands-on experiences to create knowledge and provide all students with the opportunity to develop skills and confidence to succeed in the classroom and beyond (Mainemelis et al., 2002). As previously stated, the results of this study did not indicate significance in student performance between groups, however, it should be noted that the use of experiential learning activities in laboratory sessions alongside lecture provides students with further opportunities to acquire the necessary knowledge and skills. Further, the instructors of the course utilized their personal experiences within the animal science field to provide real-world examples for students to imagine the practicality of the content being taught. Therefore, the researchers conclude that true engaging lecture can be an effective tool in college classes (Estepp et al., 2014).

Recommendations for Practice and Research

From the results of this study, researchers identified recommendations for future studies, which include replicating the study with modifications to the study design and data collection and replicating the study with modifications to the lessons taught in lab alongside guided directions for teaching assistants and instructors, to minimize the external influences on student knowledge development and skill acquisition. Additionally, researchers recommend future studies examining the performance of students on summative assessments when content and assessments are structured around hands-on learning experiences. Researchers also noted the importance of longitudinal research within the use of experiential learning laboratories on student performance, and recommend that in additional study replication, students enrolled and participate in the introductory course with experiential learning laboratories are observed throughout other animal science courses for performance.

The researchers also determined the need for recommendations for practitioners in college-level animal science courses, including the use of hands-on laboratory sessions to accompany traditional lecture-based instruction and review in introductory courses.

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