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# The Effects of Reflection and Transfer on Students' Post-Course Retention While Learning Experientially

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**Abstract**

*Experiential learning is widely used at the post-secondary level, but it requires intentional curricular planning, and proper facilitation from the instructor. The effects of experiential learning in agricultural education settings at the higher education level have not been tested extensively. Therefore, additional examination is needed to inform the practice of college faculty, especially those who wish to implement effective experiential learning in their teaching. The purpose of this study was to examine the effects of reflection mode (peer verbal or written journal reflection) and transfer level (same, near, or far transfer) on students' post-course knowledge retention in an undergraduate, animal science, laboratory course. In total, 114 students were divided among six treatment groups using a quasi-experimental, two-way, analysis of covariance (ANCOVA) design. There was no statistically significant interaction effect between reflection mode and transfer level on students' post course retention, nor were there statistically significant differences for theses main effects. While no treatment group was statistically significant, this does not mean that the mode of reflection or level of transfer were not effective practices. Rather, no reflection mode, transfer level, or combination thereof was more effective than the others. Practitioners of experiential education should seek to implement holistic models of experiential learning, which includes the facilitation of learner reflection and application, in order to foster an educative experience.*

## Introduction

Experiential learning is widely used at the post-secondary level to achieve powerful, goal-oriented, academic learning (Eyler, 2009; Kolb, 2015; Nilson, 2016). Experiential learning is also a foundational educational theory and pedagogical approach within agricultural education settings

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(Baker et al., 2012; Estepp & Roberts, 2011; Hughes & Barrick; 1993; Knobloch, 2003; Phipps et al., 2008; Roberts, 2006). Over time, researchers who have studied the effects of experiential learning in higher education settings have suggested that it can be an effective approach to foster students' deep understanding of concepts and improve their retention of knowledge (Eyler, 2009; Eyler & Halteman, 1981; Specht & Sandlin, 1991; Van Eynde & Spencer, 1988). While many higher education programs emphasize "impressing information" onto the minds of their learners, opportunities for college students to engage with educational concepts through action and experimentation are often lacking (Kolb, 2015, p. 296). In fact, Zull (2002) contended that the most critical component of the learning process is action, because our minds then have a real-world interaction to which we can connect our abstract thoughts.

While experiential learning is widely used and recommended for post-secondary agricultural education settings, it requires proper support and facilitation from the instructor, and intentional curricular planning to ensure important components of this teaching methodology are present (Baker et al, 2012; Eyler, 2009; Kolb, 2015). Such components include opportunities for reflection, engagement with related abstract content, and the connection of experiences to learning goals and outcomes. Baker et al. (2012) stated, "Agricultural education is uniquely poised to help students through an effective model of instruction that is experiential by nature" (p. 12).

However, for meaningful instruction to occur, experiential learning must be implemented effectively and holistically. Eyler (2009, p. 30) also emphasized the need for "careful structuring and supervision" of student experiences for learning to occur. This includes ensuring that the experience matches the desired educational goals and outcomes, and providing opportunities for structured reflection (Eyler, 2009). However, this raises the question, are college faculty equipped to implement such intentional efforts around experiential learning in order for it to be effective? It is known that college faculty are not always hired for their pedagogical training, but more commonly for their content expertise (Adams, 2002; Boyer, 1990). More specifically, in colleges of agricultural and life sciences, faculty have highly ranked needs for pedagogical skills related to questioning strategies, active learning strategies, fostering environments for critical thinking, and student engagement (Harder et al., 2009), which are all attainable through the effective implementation of experiential learning (Eyler, 2009; Phipps et al., 2008).

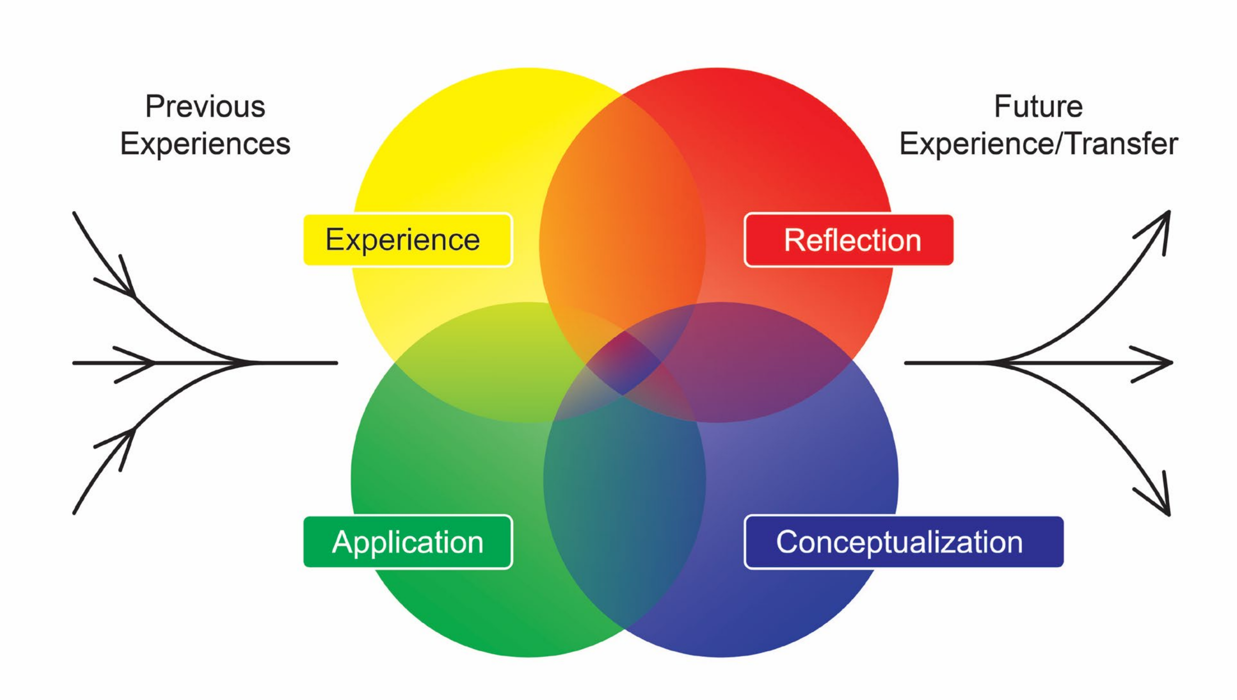
Furthermore, while there is a plethora of literature testing the effects of experiential learning practices in school-based agricultural education (SBAE) at the secondary school level (Baker et al., 2014; Coleman et al., 2020; Coleman et al., 2021; DiBenedetto et al., 2017), there is less literature available that tests the effects of experiential learning in agricultural education settings at the higher education level (Blackburn et al., 2015). Therefore, research that tests the effects of experiential learning in post-secondary agricultural education settings is needed. This research is needed for the following reasons: (a) to determine the most effective approaches by which to implement holistic and intentional experiential learning; (b) to inform the practice of college faculty, especially those who wish to implement effective experiential learning in their teaching; and (c) to contribute to the paucity of literature that tests experiential learning effects in post-secondary agricultural education settings. This study will examine two critical components, reflective observation and active experimentation, that are necessary for the holistic implementation of experiential learning. Both components are often overlooked by agricultural educators (Shoulders & Myers, 2013). In this study, we will refer to these components as reflection mode and transfer level. We will examine their effects on students short-term, post-course knowledge retention after the completion of an undergraduate, introductory, animal science laboratory course within a college of agricultural and life sciences.

## Theoretical Framework and Related Literature

This study was framed using experiential learning theory. Dewey (1938, p. 39) one of the most prominent authors of experiential learning, stated, "Experience does not go on simply inside a person. It does go on there, for it influences the formation of attitudes of desire and purpose." Those experiences which are genuinely educative are more than just action. Learning from our experiences requires connections between our environment and our mind (Dewey, 1938; Kolb, 2015; Zull, 2002). Kolb (1984; 2015) offered a process of experiential learning that included four critical components: (a) concrete experience, (b) reflective observation, (c) abstract conceptualization, and (d) active experimentation. Roberts (2006) also developed a model of the experiential learning process that synthesized the work by prominent experiential learning theorists, including Dewey (1938), Joplin (1981), and Kolb (1984). As a result, the model by Roberts (2006) included an initial focus, followed by an initial experience upon which learners would reflect. Afterwards, learners make generalizations that can be applied via experimentation and in future experiences. Additionally, all experiences are situated within the context of our past experiences, and are connected to future learning experiences (Dewey, 1938). Therefore, all three theorists' models (Joplin, 1981; Kolb, 1984; Roberts 2006) are cyclical in order to depict this consideration. Figure 1 is a model of experiential learning that synthesizes the work from the aforementioned theorists, but also emphasizes experiential learning is not a linear process.

**Figure 1**

*Model of the Experiential Learning Process*




*Note*. Figure from Coleman (2022).

That is, stages of the experiential learning process do not necessarily have to follow a specific sequence (e.g., experience followed by reflection), nor are they always isolated. For example, reflection may happen simultaneously with experience, and it may occur following an experience. Likewise, conceptualization may occur simultaneously with reflection. This model is most appropriate when used to frame this study because of the testing of the main and interaction effects of two independent variables (reflection and application).

**Reflection**

Reflection is a critical component to the experiential learning process (Dewey, 1938; Kolb, 2015; Roberts 2006). Silver (2013) defined reflection as, "a conscious exploration of one's own experiences" (p. 1). However, Zull (2002) claimed that reflection can happen either consciously or subconsciously. Reflection is the connecting bridge between theory and practice, or abstract thought and action (Schön, 1983; Zull, 2002). Schön (1983) offered two modes of reflection: reflection-in-action and reflection-on-action. Reflection-on-action occurs when one steps back from a problem or situation in order to process their experience. However, reflection-in-action occurs in the moment when one thinks about what they are experiencing in the present (Schön, 1983). The two modes, reflection-in-action versus reflection-on-action, have been tested in agricultural education, and the results have varied (Baker et al., 2014, Blackburn et al., 2015; Coleman et al., 2020; Coleman et al., 2021; DiBenedetto et al., 2017).

Other researchers and practitioners have suggested reflection strategies that focus less on when reflection occurs and more on how reflection occurs. Wright et al. (2013) found positive results from the use of hevruta, a reflection strategy that emphasizes verbal dialogue with a class peer. Additionally, numerous researchers have found positive results with the use of written reflection (Hubbs & Brand, 2005; Lamm et al., 2011; Loo & Thorpe, 2002; Thorpe, 2004; Yancey et al., 2013). Therefore, this study will focus on testing the effects of two modes of reflection (peer verbal and written journal) on students' post-course knowledge retention.

**Application via Transfer**

In Kolb's (1984, 2015) model of experiential learning, application is represented as active experimentation, which is the act of testing out knowledge in similar or new settings. When discussing this phase of the learning process, Zull (2002) stated, "Active testing is the inside-out part of learning where our ideas encounter the concrete world. Without that encounter, we cannot say if our ideas are right or wrong. We cannot say that we have learned" (p. 210). Unless a learner can transfer the concepts they have learned to other experiences and settings, it is argued that their experience was not an educative one (Dewey, 1938; Haskell, 2001; Kolb, 2015; Roberts, 2006; Zull, 2002). Haskell (2001) stated, "for it's through transfer of learning that we reach the very foundations of learning itself" (p. xvi). There are, however, multiple levels at which learning transfer can occur (Haskell, 2001; Macaulay, 2000).

Macaulay (2000) suggested that there were two primary levels of transfer: near and far transfer. Near transfer is the application that occurs in same or similar settings in which the concept was learned, while far transfer occurs when the concept is applied in a completely different context. Haskell (2001) offered six levels of transfer: (a) nonspecific transfer, (b) application transfer, (c) context transfer, (d) near transfer, (e) far transfer, and (f) displacement or creative transfer. Haskell's (2001) six transfer levels ranged on a spectrum of applying a concept in the exact same setting, arguably just practice and not true transfer, to applying concepts loosely to settings so vastly dissimilar that the learner is creating entirely new ideas or concepts. As such, we have merged the two theorists' transfer levels into three categories: (a) same transfer, (b) near transfer, and (c) far transfer (Figure 2). These will serve as the three levels of the independent variable of transfer level in this study.

**Figure 2**

*Merged Levels of Transfer*

| **Macaulay (2000)** | Near Transfer | | | | Far Transfer | |
|---|---|---|---|---|---|---|
| **Haskell (2001)** | Level 1: Nonspecific Transfer | Level 2: Application Transfer | Level 3: Context Transfer | Level 4: Near Transfer | Level 5: Far Transfer | Level 6: Creative Transfer |
| **Merged Levels of Transfer** | Same Transfer | | | Near Transfer | Far Transfer | |

## Knowledge Retention

Remembering and recalling information is a critical component to the learning process (Kolb, 2015; Zull, 2002). When taxonomizing levels of learning, Bloom et al., (1956) situated knowledge as one of the six classifications of learning He stated that, "Knowledge as defined here includes those behaviors and test situations which emphasize the remembering, either by recognition or recall, of ideas, material, or phenomena" (p. 62). Bloom et al. (1956) recognized that the knowledge classification, or remembering information, was not the most complex learning; however, it was foundational. Before someone can begin to discuss complex problems, or even have critical conversations about topics in a given field, they must have knowledge (Bloom et al., 1956). Anderson and Krathwohl (2001) revised the learning taxonomies presented by Bloom et al. (1956) and renamed the knowledge classification to remembering.

Numerous researchers, in and out of agricultural education, have tested various pedagogical approaches and their effects on knowledge retention. In a study by Flowers and Osborne (1987), the researchers found a significant difference in knowledge retention for students who were taught using a problem-solving approach over a subject matter approach. When testing the effects of an experiential learning approach versus a lecture approach, Van Eyde and Spencer (1988) found that those who were taught using experiential learning had significantly higher test scores after 13 weeks. Spect and Sandlin (1991) concurred, finding that students treated with experiential learning over lecture had significantly higher knowledge retention at six weeks. However, Baker and Robinson (2018) also tested the effects of experiential learning and direct instruction on knowledge retention and found that those treated with direct instruction had significantly less of a decrease in knowledge over time. Tran (2014) tested the effects of a cooperative learning approach over a lecture-based approach and found a significant difference in students' knowledge retention who were treated with cooperative learning. For the purpose of this study, post-course knowledge retention will serve as the dependent variable.

## Purpose and Hypotheses

The purpose of this study was to examine the effects of reflection mode and transfer level on students' post-course knowledge retention in an undergraduate, animal science, laboratory course. This research was guided by the following null hypotheses:

$H_0$ 1: There is no variance in overall mean post-course knowledge retention scores due to the interaction of reflection mode and transfer level.

$H_0$ 2: There is no difference in the overall mean post-course knowledge retention scores between reflection groups.
$H_0$ 3: There is no difference in the overall mean post-course knowledge retention scores between transfer level groups.

**Research Design**

This research is part of a large-scale research project on the effects of experiential learning in a post-secondary agricultural education setting (Coleman et al., 2023). As such, the *Publication Manual of the American Psychological Association* (2020) permits replicated methods sections when appropriate. A quasi-experimental, two-way, analysis of covariance (ANCOVA) design was utilized for this work (Kirk, 1995; Terrell, 2012). This 2x3 factorial design (Figure 3) was utilized to test the main and interaction effects of two independent variables on one dependent variable (Terrell, 2012).

**Figure 3**

*2x3 Factorial ANCOVA Design by Treatment Group for Knowledge Retention*

| | Same Transfer | Near Transfer | Far Transfer |
|---|---|---|---|
| Written Journal Reflection | Treatment Group A<br>*n* = 20 | Treatment Group B<br>*n* = 19 | Treatment Group C<br>*n* = 19 |
| Peer Verbal Reflection | Treatment Group D<br>*n* = 19 | Treatment Group E<br>*n* = 18 | Treatment Group F<br>*n* = 19 |

The first independent variable was the method of reflection, and it had two levels: written journal reflection or peer verbal reflection. The second independent variable was the level of transfer. This variable had three levels: (a) same transfer, (b) near transfer, or (c) far transfer. The dependent variable measured in this study included students' post-course knowledge retention. A pre-test score was also included as a covariate to control for students' prior knowledge.

**Participants and Procedures**

The population of interest for this study included post-secondary school students enrolled in undergraduate courses in colleges of agriculture. This experiment was conducted in the College of Agricultural and Life Sciences at the University of Florida which has a total enrollment of 4,101 undergraduate students. This quasi-experimental study employed a non-probability convenience sample in which students were enrolled in one of six pre-existing laboratory sections (Ary et al., 2010; Dooley, 2001). Specifically, the research was conducted with students enrolled in *ANS3006L: Introduction to Animal Science Laboratory* in the fall 2021 semester. This course was selected because it is a commonly taught, post-secondary, agricultural education course, and enough students enroll in this course each semester to have a large sample for conducting this type of research. Further, the course is laboratory focused, which is not only experiential in nature, but the laboratory sections also have students naturally divided into six, equally distributed, physically separated groups which was beneficial for the current research design. Students are allowed to enroll in this laboratory course if they have previously completed or are simultaneously enrolled in *ANS3006: Introduction to Animal Science*, which is the accompanying lecture course.

A total of 123 students were enrolled in the course. The course instructor informed students about the study, and students were offered an extra credit and gift card incentive for their participation. In total, all enrolled students ($N$ = 123) agreed to participate in this study. However, nine students did not complete the post-course knowledge assessment necessary to measure the dependent variable, so there were 114 individuals included in this study. We received permission from the Institutional Review Board (IRB), college administration, and course instructors, as well as consent from student participants, prior to conducting the research.

The participants were 82% female ($n$ = 93), 16% male ($n$ = 18), and 2% non-binary ($n$ = 3). A majority of participants were white ($n$ = 60), 26% were Hispanic or Latino ($n$ = 30), 12% were multiracial ($n$ = 14), 7% were Asian ($n$ = 8), and 2% were black ($n$ = 2). Most of the participants ($n$ = 60) had taken a previous post-secondary course related to animal science prior to this one. Table 1 includes the participants' characteristics by treatment group.

**Table 1**

*Participant Characteristics by Treatment Group for the Dependent Variable of Post-Course Retention*

| | Group A | | Group B | | Group C | | Group D | | Group E | | Group F | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Characteristic | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| Gender | | | | | | | | | | | | |
| Male | 3 | 15 | 1 | 5 | 4 | 21 | 4 | 21 | 3 | 17 | 3 | 16 |
| Female | 14 | 70 | 18 | 95 | 15 | 79 | 15 | 79 | 15 | 83 | 16 | 84 |
| Non-Binary | 3 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Race/Ethnicity | | | | | | | | | | | | |
| White | 9 | 45 | 11 | 58 | 14 | 74 | 8 | 42 | 6 | 33 | 12 | 63 |
| Hispanic or Latino | 5 | 25 | 4 | 21 | 3 | 16 | 5 | 26 | 10 | 56 | 3 | 16 |
| Multiracial | 2 | 10 | 2 | 11 | 2 | 11 | 3 | 16 | 1 | 6 | 4 | 21 |
| Asian | 4 | 20 | 1 | 5 | 0 | 0 | 2 | 11 | 1 | 6 | 0 | 0 |
| Black | 0 | 0 | 1 | 5 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 |
| Previous AnSci Course | | | | | | | | | | | | |
| Yes | 11 | 55 | 9 | 47 | 10 | 53 | 9 | 47 | 11 | 61 | 10 | 53 |
| No | 8 | 40 | 10 | 53 | 9 | 47 | 10 | 53 | 7 | 39 | 9 | 47 |

*Note*. Some totals may not equal 100% because of missing data or rounding.

The six treatment groups were drawn from the six preexisting laboratory course sections. As such, selection bias was a recognized threat to internal validity, and was a limitation of this study (Ary et al., 2010). While the selection of participants was not completely randomized, the treatments were randomly assigned by the researchers to the six preexisting groups.

In addition to selection bias, there were 10 other threats to internal validity listed by Ary et al. (2010), nine of which were controlled for by the design of this study. They were (a) history, (b) maturation, (c) testing, (d) instrumentation, (e) statistical regression, (f) selection-maturation interaction, (g) experimenter effect, (h) subject effect, and (i) diffusion. As previously mentioned, nine students did not complete the post-test, so it is possible that experimental mortality could be a threat; however, this attrition rate was only 7%, so it is not likely. No students dropped out of the study over the course of the semester, and the average attendance for the course was 93%. Table 2 includes a summary of the percentage of student attendance by treatment group and week.

**Table 2**

*Percentage of Student Attendance by Treatment Group*

| Group | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 | W9 | W11 | W12 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 95 | 100 | 86 | 100 | 90 | 95 | 100 | 90 | 86 | 86 | 90 | 93 |
| B | 100 | 100 | 86 | 100 | 95 | 100 | 95 | 95 | 100 | 95 | 90 | 96 |
| C | 100 | 100 | 90 | 100 | 100 | 90 | 100 | 85 | 85 | 95 | 80 | 93 |
| D | 100 | 100 | 95 | 90 | 100 | 90 | 100 | 95 | 100 | 86 | 67 | 93 |
| E | 100 | 100 | 95 | 100 | 95 | 100 | 90 | 76 | 86 | 81 | 90 | 92 |
| F | 100 | 95 | 89 | 89 | 95 | 84 | 100 | 100 | 95 | 95 | 79 | 93 |

*Note*. No treatment was provided in week 10; therefore, week 10 attendance is not reported.

Field notes that included researcher observations were recorded for most weeks to assist in controlling for any deviations from protocol that could have been a threat to validity, and these are included as Appendix L. Over the course of 14 weeks, the six laboratory course sections met weekly for one hour and 55 minutes, which totaled 12 class meetings and two holiday weeks. Laboratory meetings were held from 12:50 p.m. to 2:45 p.m. and from 3:00 p.m. to 4:55 p.m., on Tuesdays, Wednesdays, and Thursdays, for a total of six separate laboratory sections each week.

In addition to the face-to-face lab meetings, students were expected to complete pre-lab assignments independently online before attending each weekly lab. The pre-lab assignments focused on the development of students' abstract knowledge prior to attending the in-person, hands-on lab portion of the course. Pre-lab assignments included informational videos, PowerPoints©, and readings focused on the weekly topic. Weekly topics included (a) livestock terminology, health, and management, (b) nutrition, (c) reproduction, (d) poultry shell egg processing and products, (e) poultry anatomy and physiology, (f) beef production, (g) dairy products and processing, (h) swine production, (i) meats – assigning value, (j) dairy calf and herd management and milking, (k) meat products and palatability, and (l) equine management. All experimental treatments were administered by the course instructors during the face-to-face class meetings. The same instructors taught all six sections of the course, so instructional delivery was consistent across treatment groups and instructor effect was controlled for.

For the independent variable of reflection mode, each lab answered up to five reflection questions, which were pre-developed by the course instructor and were aligned with the weekly topic and objectives. The reflection treatment was administered once weekly during 11 of the 12 weeks of instruction. The treatment was administered by the instructor during the face-to-face class meeting, and the treatment was also supervised by the researchers.

All treatment groups were prompted with the same reflection questions, but the method by which the groups were prompted to reflect varied. Treatment groups A, B, and C were prompted to reflect via written journal reflection, and treatment groups D, E, and F were prompted to reflect via verbal peer reflection. Groups who were assigned written journal reflection were given a bound journal at the beginning of the semester. Students were given the reflection questions and asked to independently write their thoughts about each question in their journal. Groups who were assigned verbal peer reflection were given the reflection questions and asked to discuss them with a partner. Time allotted for reflection varied each week due to the varying number of reflection questions (approximately 7–10 minutes), but the same amount of time was allotted for reflection across treatment groups each week.

For the independent variable of transfer level, students were administered an exercise in the face-to-face class meetings. The exercises were developed by the researcher and course instructor and included a case vignette problem or situation in which students were to apply the animal science concepts being discussed that week. Macaulay (2000) recommended the use of case studies or problem scenarios to facilitate transfer of learning. Students were broken into small groups and were asked to work through the vignette with their fellow group members. Treatment groups A and D received a vignette that prompted same transfer, groups B and E received a vignette that prompted near transfer, and groups C and F received a vignette that prompted far transfer. At the end of the exercise, instructors debriefed the entire class and clarified any questions students had. The transfer level treatment was administered once weekly during eight of the 12 weeks of instruction.

## Instrumentation

### Course pre-test (covariate)

As this is a junior-level, introductory animal science course, students who are enrolled typically come with an array of related experiences and existing knowledge about the course topics. Therefore, a pre-test was given before the first class meeting to assess students' prior knowledge, which met the assumption that the covariate was measured before treatment was administered. The test was administered via the Canvas learning management system, which is used for all University of Florida courses; thus, students were familiar with this testing system.

To assemble the pretest, all the weekly, multiple-choice, quiz questions were compiled into a question bank. From there, 26 questions were randomly selected to be included in the pre-test. The face and content validity of the pretest was evaluated by an expert panel consisting of two animal science faculty members, two agricultural education faculty members, and one doctoral graduate student of agricultural education. As a result, nine of the questions were adjusted for readability, grammar, spelling, and clarity. Other assumptions about the covariate (linearity and homogeneity of regression slopes) were tested using SPSS. To test linearity, a scatterplot was used to check for curvilinear relationships for each group. The results showed there were none. Therefore, the assumption of linearity was met. Homogeneity of regression slopes was tested by conducting a test of between-subjects effects to determine whether there was a statistically significant relationship between the covariate and treatment. There was no statistically significant relationship, $F(5, 102) = 1.36$, $p = .246$; as such, this assumption was also met. The scores from the pre-test were utilized as a covariate to control for students' previous knowledge as a threat to validity for this study.

**Post-course knowledge retention assessment**

The instrument utilized to measure students' post-course knowledge retention was an identical version of the 20-question course pre-test, described above. The test was administered via the Canvas learning management system during week 15, which was the week after the last week of instruction and treatments. When reviewing studies around knowledge retention, there is a wide spectrum of time that researchers have used to measure learners' knowledge retention. All of the researchers provided little to no justification for the time intervals they selected: (a) Flowers and Osborne (1987) – one week, (b) Van Eyde and Spencer (1988) – two and 13 weeks, (c) Reaves et al. (1993) – three weeks, (d) Tran (2014) - two and six weeks, (e) Spect and Sandlin (1991) – six weeks, (f) Baker and Robinson (2018) – six weeks, (g) Zieber and Sedgewick (2018) – three months, and (h) Brown et al. (2014) – six months.

We administered the post-course assessment one week following instruction for two primary reasons. The first reason was to limit the amount of mortality we would have. Even just one week following instruction, we still saw a loss of nine participants. Waiting longer would likely have resulted in a much larger loss. Secondly, since this was a cumulative assessment, test items focused on course content from the entire semester. Therefore, this assessment included content that ranged in exposure from 14 weeks to one week prior to taking the assessment. Finally, it is important to note that this assessment was not given as an exam in the course. Rather, students were asked to complete the assessment and, in return, were awarded a 5-point participation grade. This approach was selected because we wanted students to focus more on taking the assessment as an authentic measurement of what they retained from the course while removing the pressure of obtaining the best possible grade.

**Data Analysis**

All data were analyzed with SPSS Version 28. A factorial ANCOVA was utilized for determining the main and interaction effects of the two independent variables (Field, 2018; Terrell, 2012). Assumptions regarding the ANCOVA that were not necessarily met by the design of this study (normality and homogeneity) were examined prior to conducting the procedure (Terrell, 2012). Assumptions of normality were analyzed within each of the six treatment groups, first by using the Kolmogorov-Smirnov (K-S) tests. The knowledge scores for each of the treatment groups did not deviate significantly from normal: (a) Group A, $D(20) = .139$, $p = .200$; (b) Group B, $D(19) = .169$, $p = .155$; (c) Group C, $D(19) = .129$, $p = .200$; (d) Group D, $D(18) = .124$, $p = .200$; (e) Group E, $D(19) = .142$, $p = .200$; (f) Group F, $D(19) = .136$, $p = .200$. Levene's test was conducted to measure homogeneity of variance, and this yielded a result of $F(5, 108) = 0.35$, $p = .881$. While K-S and Levene's tests are commonly used, Field (2018) suggested caution when using the procedure to test for homogeneity of variance because it can be overly sensitive with large sample sizes and not sensitive enough for small samples. Therefore, Field (2018) recommended the inclusion of other indicators of normality and homogeneity, such as histograms and Q-Q plots, when examining ANCOVA assumptions. As such, histograms and Q-Q plots have been included as Figures 4 and 5, respectively.

**Figure 4**

*Histograms of Post-Course Retention Scores by Treatment Group*

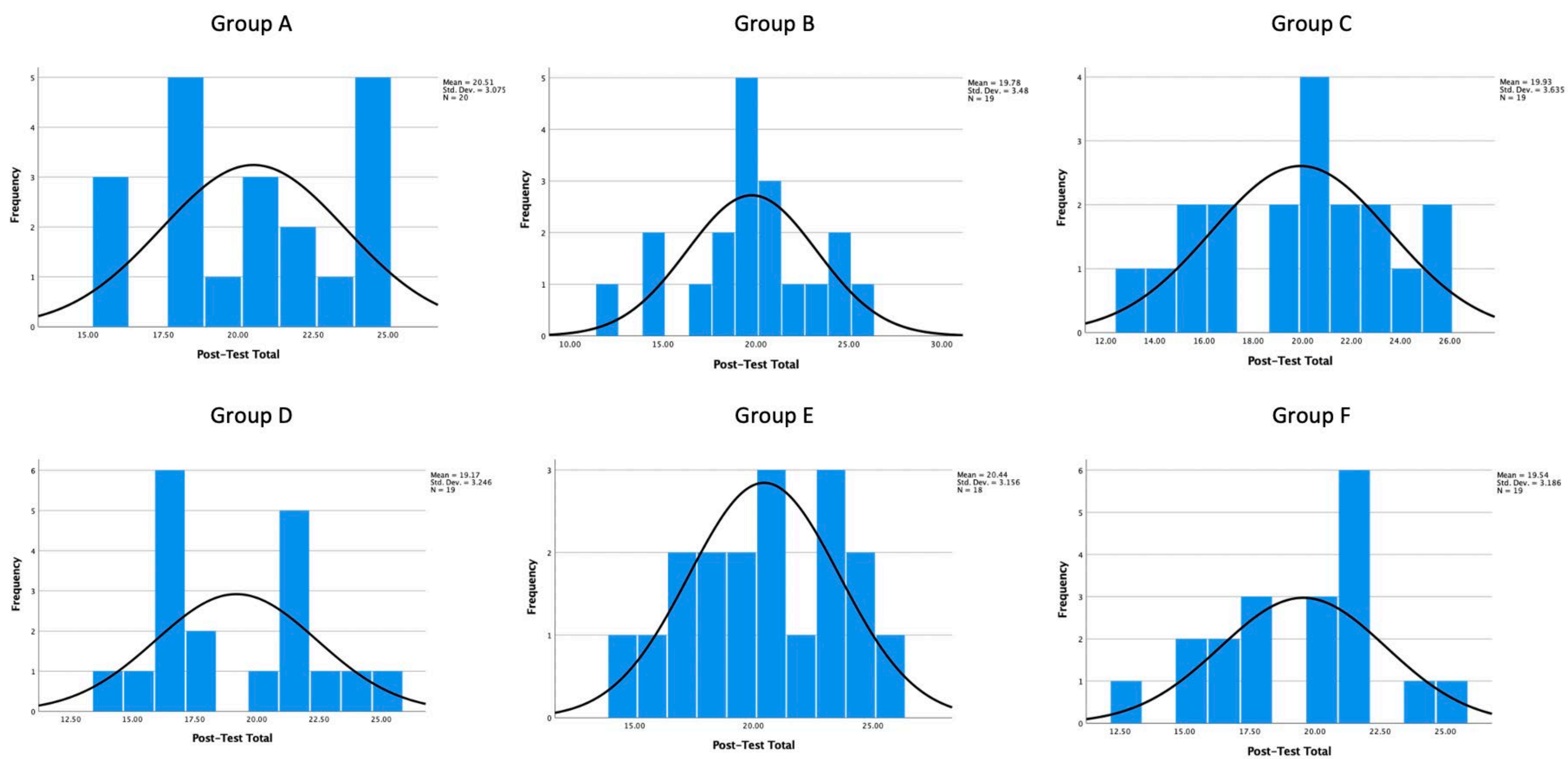
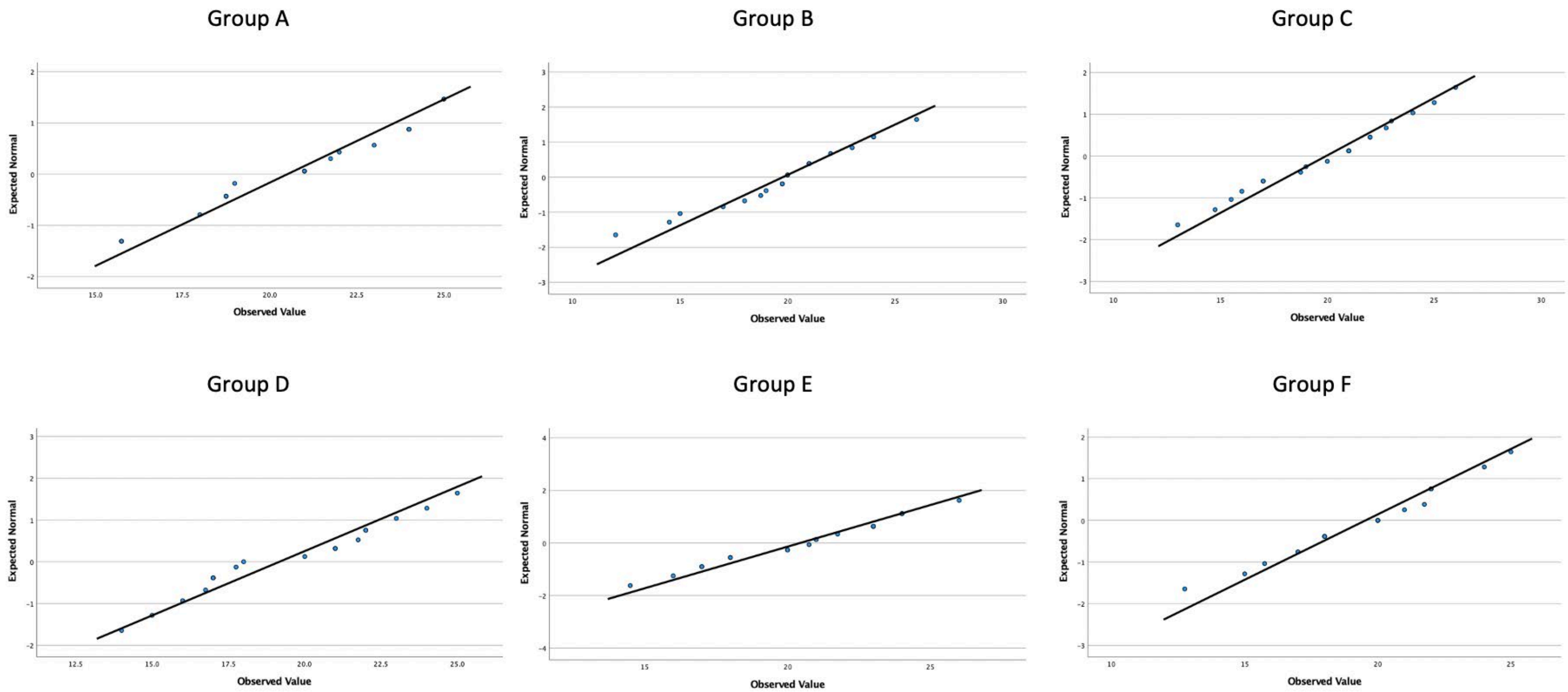


**Figure 5**

*Q-Q Plots of Post-Course Retention Scores by Treatment Group*



An a priori alpha level of .05 was set for measuring statistical significance. Significant and practical effects were reported as findings. The researchers either rejected or failed to reject the null hypotheses based on their statistical significance (Ary et al., 2010). The practical significance of measures that were deemed statistically significant were reported as partial $\eta^2$ with the following sizes: (a) 0.01 – small effect size, (b) 0.06 – medium effect size, and (c) 0.14 – large effect size (Cohen, 1988; Miles & Shevlin, 2001).

## Results

Means, standard deviations, adjusted means, and standard errors are presented in Table 3, and the results of the ANCOVA are presented as Table 4. The covariate of prior knowledge (pretest scores) was significantly related to the participants' post-course knowledge retention, $F(1, 107) = 8.15$, $p = .005$, partial $\eta2 = .071$ and observed power = .81. After adjusting for prior knowledge scores, there was no statistically significant interaction effect between the two independent variables, $F(2, 107) = 0.99$, $p = .376$. Therefore, the first null hypothesis failed to be rejected. After analyzing the main effect of reflection mode, there was no statistically significant effect, $F(1, 107) = 0.45$, $p = .503$. There was also no statistical significance for the main effect of transfer level, $F(2, 107) = 0.64$, $p = .530$. Thus, the second and third null hypotheses also failed to be rejected. Figure 6 displays the adjusted mean post-course retention scores by treatment group.

**Table 3**

*Pretest, Post-Course Retention, and Adjusted Post-Course Retention Scores as a Function of Reflection Mode and Transfer Level*

| | Pretest (Covariate) | | Post-Course Retention | | Adjusted Post-Course Retention | |
|---|---|---|---|---|---|---|
| Source | *M* | *SD* | *M* | *SD* | *M* | *SE* |
| Same Transfer | | | | | | |
| Written Reflection | 12.56 | 3.35 | 20.51 | 3.08 | 20.41 | 0.72 |
| Verbal Reflection | 12.19 | 3.69 | 19.17 | 3.25 | 19.22 | 0.73 |
| Near Transfer | | | | | | |
| Written Reflection | 11.21 | 3.56 | 19.78 | 3.48 | 19.78 | 0.74 |
| Verbal Reflection | 10.95 | 2.84 | 20.44 | 3.16 | 20.75 | 0.76 |
| Far Transfer | | | | | | |
| Written Reflection | 12.19 | 2.62 | 19.93 | 3.64 | 19.92 | 0.73 |
| Verbal Reflection | 13.74 | 4.23 | 19.54 | 3.19 | 19.23 | 0.75 |

**Table 4**

*Analysis of Covariate of Mean Post-Course Retention Scores as a Function of Reflection Mode and Transfer Level, With Pretest Knowledge Scores as a Covariate*

| Source | *df* | *SS* | *MS* | *F* | *p* | $\eta^2$ |
|---|---|---|---|---|---|---|
| Covariate | 1 | 83.32 | 83.32 | 8.15 | .005 | .071 |
| Reflection | 1 | 4.62 | 4.62 | 0.45 | .503 | .004 |
| Transfer | 2 | 13.05 | 6.53 | 0.64 | .530 | .012 |
| Reflection x Transfer | 2 | 20.20 | 10.10 | 0.99 | .376 | .018 |
| Error | 107 | 1,093.82 | 10.22 | | | |
| Total | 114 | 46,334.06 | | | | |

**Figure 6**

*Adjusted Post-Course Retention Means by Treatment Group*

| | Same Transfer | Near Transfer | Far Transfer |
|---|---|---|---|
| Written Journal Reflection | Treatment Group A $M_{adj} = 20.41$ | Treatment Group B $M_{adj} = 19.78$ | Treatment Group C $M_{adj} = 19.92$ |
| Peer Verbal Reflection | Treatment Group D $M_{adj} = 19.22$ | Treatment Group E $M_{adj} = 20.75$ | Treatment Group F $M_{adj} = 19.23$ |

## Conclusions, Implications, and Recommendations

The lack of interaction effect supports that reflection mode and transfer level are independent of one another when analyzing post-course knowledge retention scores. The lack of significant main effects also suggests that neither mode of reflection nor any of the three transfer levels were significantly more effective in increasing students' post-course knowledge retention scores. When considering reflection mode, this finding is congruent with Blackburn et al. (2015), who found no statistically significant difference between written and verbal reflection modes, and that both modes were equally effective.

While no treatment group was statistically significant, this does not mean that the mode of reflection or level of transfer were not effective practices. Rather, no reflection mode, transfer level, or combination thereof was more effective than the others. As such, it is worthy to note that the group post-course knowledge retention score means ranged from 19.17 points to 20.51 points out of a possible 26 points, meaning the groups' average scores ranged from 73.7% to 78.9%, which is a C grade in this course. Also, consider that these scores were from an exam that was given for a participation grade, on which students were asked to complete the assessment to the best of their ability to get an authentic measurement of their post-course knowledge retention. Therefore, these mean scores are not unsupportive of any reflection mode or transfer level used in this design. We recommend practitioners use either verbal reflection (Wright et al., 2013), written reflection (Hubbs & Brand, 2005; Lamm et al., 2011; Loo & Thorpe, 2002; Thorpe, 2004; Yancey et al., 2013), or even combinations of both when aiming for effective post-course knowledge retention. It is possible that a one versus the other approach to reflection may not be the most effective when designing experiential learning instruction.

While no transfer level was significant, the inclusion of application opportunities through which learners can transfer concepts to practical settings are still critical for the learning process (Haskell, 2001; Kolb, 2015; Macaulay, 2000; Zull, 2002). In this study, case vignettes set in same, near, and far transfer settings were used as the treatment to teach for transfer ability. In addition to case studies, Macaulay (2000) also recommended the use of a variety of methods and tools for practitioners to consider when teaching for transfer ability. These methods included role playing, workshops, expert consultants and lectures, and supportive content literature and resources (Macaulay, 2000). However, these variables alone are not the only tools needed to teach for transfer ability. In fact, Haskell (2001) suggested that designing instruction in sequential, minute-by-minute steps, especially as we do for experimental design studies, is not the most effective model for teaching and learning. So, while there are methods and variables of transfer learning that can be tested experimentally for theory, this does not mean it should set an exact formula for how we approach real-life education (Haskell, 2001). The reality is, practitioners should also recognize that teaching for transfer requires a well-taught and educative learning experience, the integration of previous and necessary contextual knowledge, and methods that encourage learners to draw connections and put their learning into practice (Haskell, 2001; Macaulay, 2000).

This study measured post-course knowledge retention in the week following the final instructional week of the course, a practice similar to Flowers and Osborne (1987). However, other studies that have measured knowledge/post-course knowledge retention as the dependent variable have also ranged from two weeks to six months following instruction (Baker & Robinson, 2018; Brown et al., 2014; Reaves et al., 1993; Spect & Sandlin, 1991; Tran, 2014; Van Eyde & Spencer, 1988; Zieber & Sedgewick, 2018). Therefore, future replications of this or similar studies could measure knowledge/post-course knowledge retention at longer observation intervals. However, in this study, collecting the measure just one week following instruction resulted in attrition rates of 7% ($n = 9$). Thus, experimental mortality will likely be a challenge for studies who measure retention at longer observation intervals.

Finally, this study focused on the effects of only two components of experiential learning – reflection and application. While replication of this study is recommended, future research should also analyze the effects of other experiential learning components (experience and conceptualization). Agricultural education at the post-secondary level is well-positioned to include effective experiential learning. In order to do this, practitioners should strive to implement holistic models of experiential learning, which includes the four components of experience, reflection, conceptualization, and reflection, to foster an educative experience (Dewey, 1938; Joplin, 1981; Kolb, 2015; Roberts, 2006). This study is a testament that regardless of the specific method used for each of the components, when educators are intentional about their instructional planning and practice, experiential learning becomes an effective educational tool that leads to powerful, goal-oriented, academic experiences (Baker et al., 2014; Eyler, 2009; Roberts, 2006).

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