Using Review Sessions to Promote Student Learning in an Animal Reproduction Course

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Abstract

The purpose of this study was to evaluate the effectiveness of question-and-answer based review sessions to stimulate student learning (assessed as an increase in exam score) in an animal reproduction course. Data were collected over 2 semesters from students (n=107) enrolled in a Reproductive Physiology course at a major land grant university. Prior to each of the three lecture exams, students had the option of attending a review session the evening (1700 to 1900 hrs) before the exam. Student attendance at review sessions was approximately 30% of the class. Review session attendance was positively correlated to exam score ($P<0.10$) and student performance on medium and high cognitive level questions ($P<0.03$). Overall, students who attended the review sessions earned more points on the exams than those who did not (76.1±0.98 vs. 69.6±0.98, respectively). Students who attended the review sessions required the same amount of time to complete Exam 1 and Exam 2 as those students who did not attend ($P>0.22$), but spent more time answering Exam 3 questions ($P=0.08$). In conclusion, improved exam scores as a measure of student learning were associated with student participation in review sessions.

Introduction

Review sessions, held outside of the regular class meeting time and mediated by a course instructor or teaching assistant, are designed to provide students additional support and preparation for exams. These sessions can consist of a variety of formats including oral study sessions, administration of a practice exam, or traditional question-and-answer opportunities with instructors (Neef et al., 2007). Cross (1987) stated that students learn more when actively involved in the learning task, thus student involvement in review sessions has the potential ability to promote student learning and success within the classroom. However, student participation and subsequent academic performance, beyond exam scores, following review sessions is not commonly empirically evaluated.

Aamodt (1982a) reported that students who attended a question-and-answer based review session the night before an exam scored higher on a cumulative final exam in an introductory psychology course than students who did not attend. In a subsequent study, Aamodt (1982b) evaluated which aspect of the review session was most beneficial for the students. Students who attended a question-and-answer review session that consisted of key concepts scored better on the final exam than students who attended a general question-and-answer review session or did not attend a review session (Aamodt, 1982b). Based on these papers, it was concluded that reviewing key information the night before an exam provided the students with the instructor's exam expectations, which may explain the improved exam score.

Several studies have examined the effectiveness of using practice exams as a method of review (Balch, 1998; Bol and Hacker, 2001). This method of review has shown improvement in student performance via increased exam scores. Exam scores were greatest when review questions, which resembled the exam in form and content, were provided to students compared to students who did not receive review questions (Balch, 1998; Bol and Hacker, 2001). Subsequent studies compared the effectiveness of various review session types and reported that review sessions which included a review of instructor expectations or realistic practice exams were the most effective, followed by the sessions involving only a review of instructor expectations (Rust et al., 2003; Neef et al., 2007). Review sessions that included only question-and-answer opportunities without review of important material (Aamodt, 1982b) or unrepresentative practice opportunities (Neef et al., 2007) did not produce large improvements in exam performance.

Using exam scores has been the predominant mode to evaluate student learning and / or success following participation in review sessions (Aamodt, 1982b; Balch, 1998; Bol and Hacker, 2001, Rust et al., 2003; Neef et al., 2007). This approach would be supported if students were challenged to think on multiple cognitive levels formulated around the principles of Bloom's Taxonomy (Bloom et al., 1956). Assessment of student learning is

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dependent upon the complexity of the exam questions in this system. If exam questions primarily contain lower cognitive level questions, then exam scores following participation in a review session may solely reflect a student's ability to memorize material as opposed to learning it. Using Bloom's approach, exam questions are categorized from simple knowledge to complex synthesis and evaluation of the subject information to stimulate deeper thought or creativity in the field (Bloom et al., 1956). Students who successfully develop greater cognitive abilities and critical thinking skills are more likely to have greater success in their careers (Paul, 2004). Therefore, it is of interest to evaluate if student participation in question-and-answer based review sessions improves a student's ability to acquire these skills.

Purpose of Study

The purpose of this study was to evaluate the effectiveness of question-and-answer based review sessions to stimulate student learning in an animal reproduction course as assessed by higher scores on exams and on answers to questions requiring a higher level of cognitive understanding. The following objectives and hypotheses were developed and tested to meet this purpose.

Describe the exam scores of Reproductive Physiology students in relation to the level of student participation in an extra-curricular review session.

Investigate if student participation in question-and-answer based review sessions results in improved student performance and reduced time needed to complete exams compared to their peers who did not attend the review sessions.

Evaluate if student participation in question-and-answer based review sessions improves student learning as measured by higher exam scores and better performance on exam questions requiring higher level thinking skills.

To accomplish objectives 2 and 3, the following hypothesis was developed:

H1: Students who attended the question-and-answer-based review sessions would have significantly higher scores and require less time to complete their exams compared to those who did not attend.

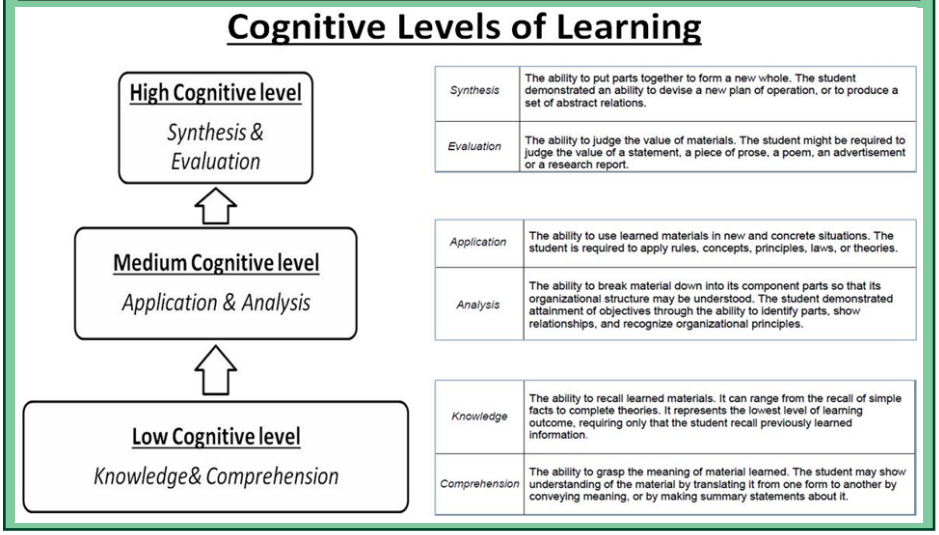
Materials and Methods

Reproductive Physiology at North Carolina State University was chosen as a representative course because the course material is a universal component of animal science curricula nationwide. Students enrolled in the course enter with a wide range of academic and animal experience. This investigation was a descriptive census (all members of the class) study (Patton, 2002). Due to the restrictions of a census study, participants were not selected randomly but were considered representative of undergraduates in the College of Agriculture and Life Sciences who had previously or will enroll in this course. The goal of this study involved efforts to improve instruction and thus was deemed exempt by the North Carolina State Institutional Review Board and no identifying information was used in the data analysis.

Assessment and Data Collection

The reproductive physiology course had 3 lecture exams and a cumulative final exam representing sixty percent of the overall grade of the course. The lecture exams tested students using a variety of formats including multiple answer- multiple choice, true or false, fill in the blanks, short answer and essay questions. In the second year, short answer and essay questions were ranked according to Bloom's taxonomy as low, medium and high to evaluate student performance based on cognitive level of understanding (Figure 1). Low levels of cognition included basic knowledge and comprehension, medium levels of cognition focused on application and analysis of the information and high levels of cognition focused on a student's ability to synthesize and effectively evaluate the information. For this study, data were collected on the 3 lecture exams. Students enrolled in the course had the option of attending an extra-curricular question-and-answer based review session held the evening before each of the three lecture exams. These review sessions were optional; students received no points for attending any of the sessions and were not penalized for not attending any of the sessions. The time (1700 to 1900 hrs) of the review session was chosen to provide the students adequate time to prepare for the exam prior to attending the review session. During the review sessions, prepared students addressed questions on the major concepts covered on each exam. Review sessions were not simply a reiteration of the lectures. Students in attendance were engaged to describe and

Figure 1: Cognitive levels of learning, adapted from Bloom's Taxonomy, used to designate exam questions to either low, medium or high cognitive levels used to evaluate the students knowledge of the course information.



teach the concepts in question to other attendants to stimulate student-centered learning. Each exam's review session was conducted under the supervision of the faculty instructor and therefore students who attended help sessions received no "inside information" about the exams. Overall, the review sessions lasted until all questions were answered (approximately 1.5 hours).

Data were collected in several ways. A teaching assistant documented student attendance at every review session, which was recorded in Microsoft Excel® until analysis following completion of the course. Time needed to complete the exam was recorded when a student returned his or her exam to the instructor. This value was determined by subtracting the finished time from the time the exams were distributed. All exams were graded by the faculty instructor and the answers were recorded in Microsoft Excel® until analysis. Short answer and essay questions were ranked by the faculty instructor as requiring low, medium and high cognitive skills to successfully complete the question prior to administering the exam, but this information was not provided to students. The total number of points earned for each of the cognitive levels was recorded on a per exam basis. Student performance based on cognitive level was determined by calculating the total number of points he or she earned in relation to the total number available per level of cognition. Scores are given as percentages and were assigned letter grades based on the following grading scale: A, 90%–100%; B, 80%–89%; C, 70%–79%; D, 60%– 69%; F, less than 60%.

Data were analyzed using Proc Mixed of SAS 9.2 (SAS Inst. Inc., Cary, NC). For the descriptive statistics, which included the exam scores and level of student participation in review sessions, means and standard deviations were calculated in Microsoft Excel®. Exam scores and student participation in review sessions were converted to percentages for ease of comparison. Review session attendance was correlated to the exam outcome, time needed to complete the exam and student performance based on cognitive level of understanding. P values of ≤ 0.05 represented significant differences, whereas P values of > 0.05 and ≤ 0.1 represented a statistical tendency.

Results and Discussion

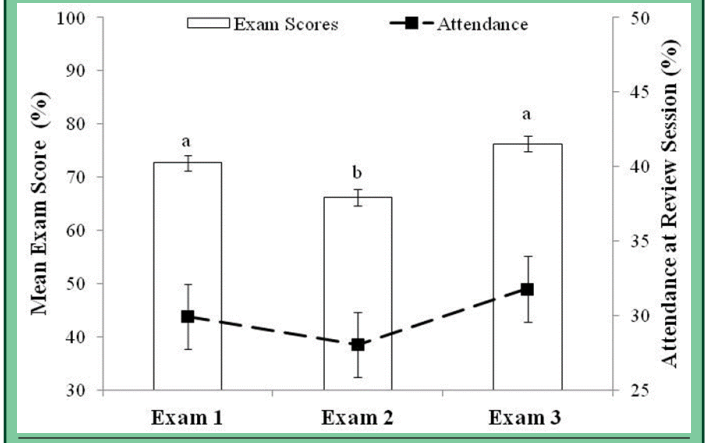
The target population consisted of 107 undergraduate students (18% male and 82% female) from a reproductive physiology course during the Fall semesters of 2012 and 2013. Of the 107 students, 91% were Animal Science majors, 6% were Zoology majors and 3% were exchange or non-degree seeking students. Additionally, students in the course were distributed into the following academic ranks: juniors (50%), seniors (31%), sophomores (16%) and exchange students (3%).

Exam scores for exam 1, 2 and 3 displayed a typical bell curve in student performance with the mean scores of the exams over the two semesters presented in Figure 2. Exam 3 had the highest mean at 76.3% (SD = 14.06), followed by Exam 1 with a mean of 72.7% (SD = 14.76) and Exam 2 had the lowest mean of 66.2% (SD = 14.58), which was significantly lower compared to the other exams (Figure 2; $p<0.01$). Elevated exam scores for the third exam may have been a result of several contributing factors, such as increased motivation to improve course grade and familiarity with exam format.

Approximately 30% of the students enrolled in the course participated in the extra-curricular review sessions (Figure 2). There was no difference in the number of students who participated in the review sessions prior to exams 1, 2 or 3 (29.9%, 28.0% and 31.8%, respectfully; Figure 2; $p>0.05$). These data are similar to previous reports by Moore (2008) which observed only a 26% attendance rate at optional help sessions in an introductory biology course. In a follow up report, Jensen and Moore (2009) reported that lower GPA students did not attend the optional help sessions scheduled just prior to three exams. In the current study, students who earned B or C letter grades on exams were more likely to attend review sessions than lower scoring students, regardless of when the sessions were offered during the semester; this is in agreement with Jensen and Moore's findings.

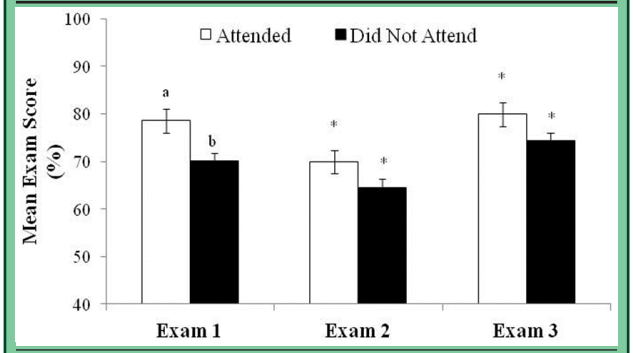
Students who attended the question-and-answer based review session prior to the exams had significantly higher scores (Exam 1: 78.56 %vs. 70.12%; Exam 2: 69.92% vs. 64.60%; Exam 3: 79.96% vs. 74.32%) compared to those students who did not attend (Figure 3). These data are consistent with previous reports demonstrating improvement in student scores following participation in a traditional question-and-answer based review session (Aamodt, 1982a, 1982b). It was hypothesized that students who attended the question-and-answer-based review sessions would be better prepared for the exams and require less time to complete their exams compared to students who did not attend the review sessions. Students who attended the question-and-answer based review sessions prior to the exam required the same amount of time to complete their exams (Exam 1: 62.10 vs. 59.83 minutes; Exam 2: 64.37 vs. 61.24 minutes; Exam 3: 70.47 vs. 64.16 minutes) as those students who did not attend (Figure 4).

Figure 2: Mean scores for exams 1, 2 and 3 for the entire class (left axis) and the percentage of studentswho attended the review sessions (right axis) over the 2 semesters observed in this study.



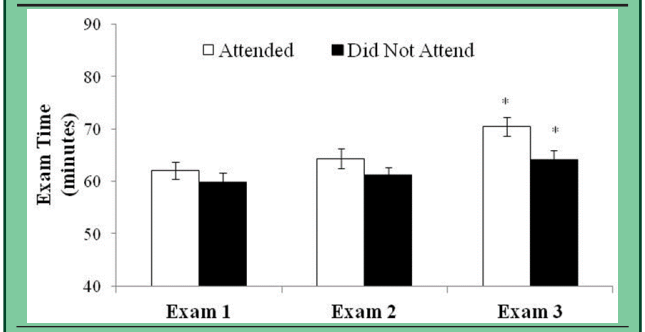
Different letters denote a significant difference in overall exam scores ($p< 0.01$)

Figure 3: Comparison of the mean exam scores for exams 1, 2 and 3 between those students who attended the question-and-answer based review session and students who did not attend.



Different letters denote a significant difference within an exam ($p < 0.01$), asterisks indicate a tendency within an exam ($0.05 < p < 0.1$).

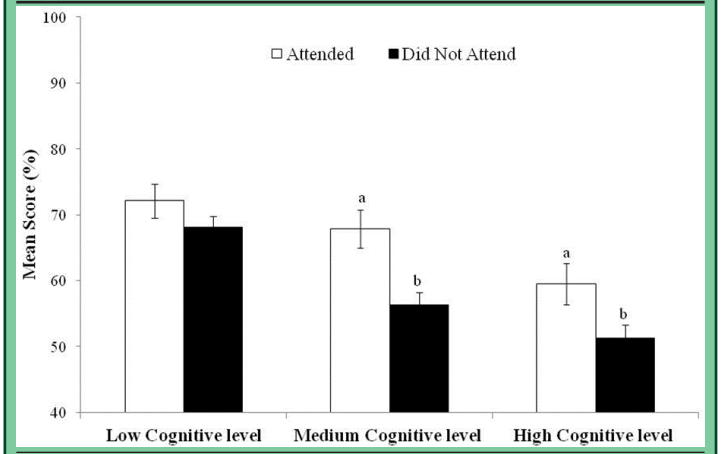
Figure 4: Comparison of time required, in minutes, to complete exams 1, 2 and 3 between those students who attended the question-and-answer based review session and students who did not attend.



Asterisks indicate a tendency within an exam ($0.05 < p < 0.1$).

Student responses on short answer and essay questions ranked with low, medium and high cognitive levels of learning were evaluated to determine if participation in question-and-answer based review sessions improved student learning. Students who attended the question-and-answer based review session had significantly higher scores on medium (67.90% vs. 56.33%) and high (59.46% vs. 51.23%) cognitive level questions compared to those students who did not attend (Figure 5). This difference was not observed in scores from those who attended (72.10%) compared to those who did not attend (68.06%) the review session with low cognitive level questions (Figure 5). Students who participated in the review sessions provided thoughtful, thorough answers with necessary support to complete their argument compared to students who did not participate in the review session. In order to develop these detailed responses, it would be expected that students would require additional time; however, this was observed only for Exam 3. According to Kapinus (2014), faulty written responses reflect a lack of experience or knowledge of the subject material. The skills and knowledge that underlie understanding the expectations of and writing responses to, higher cognitive level questions requires deliberate instruction of strategies and experience (Kapinus, 2014). Active participation in question-and-answer based review sessions could provide students with necessary knowledge and skillset to improve student learning in an animal reproduction course.

Figure 5: Comparison of the mean score (%) of short answer and essay questions ranked with either low, medium or high cognitive levels of learning for students who attended the question-and-answer based review session and students who did not attend.



Different letters denote a significant difference in exam scores within cognitive level of learning ($p < 0.05$).

Summary

Traditional question-and-answer based review sessions have been shown to be an effective supplemental learning method. Improvement of exam scores and student learning were associated with student participation in review sessions. Participation in this type of review session increased the probability of student success in the form of improved test performance and course grades. A student's ability to provide thoughtful, thorough answers to essay questions that required a higher level of cognition was positively correlated with active participation in the question-and-answer based review session.

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