



Collaborative Exams in an Undergraduate Anatomy and Physiology Classroom Enhance Students’ Perceived Learning and Knowledge Retention

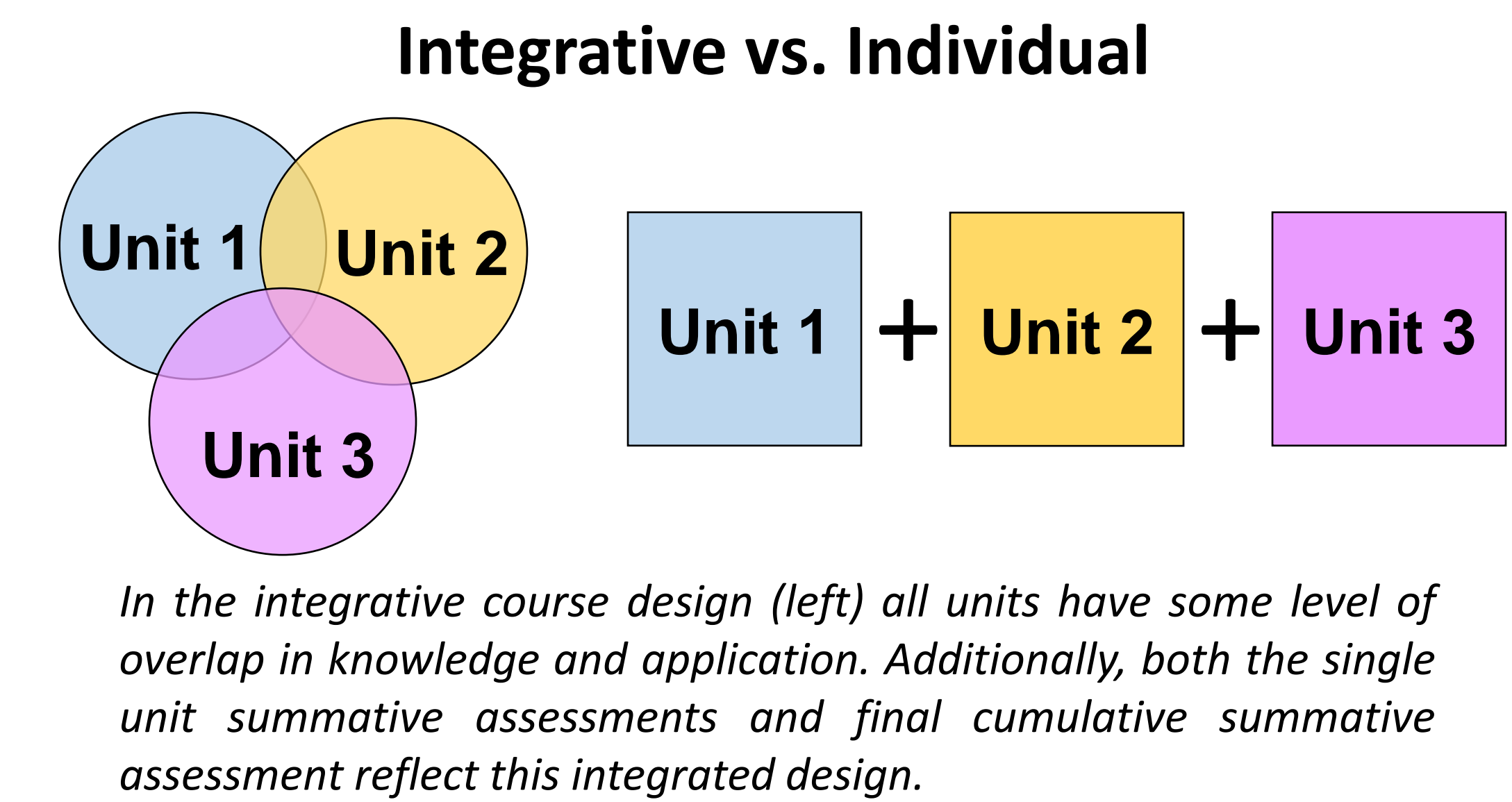
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Background

- In the complete redesign of a year-long undergraduate human anatomy and physiology course, the course moved to an integrated design. This design requires that students retain knowledge throughout the year-long course vs. the more traditional model of individual unit testing.



- Collaborative-group testing has previously been reported to enhance student retention and learning in graduate level courses (Giuliodori et al., 2008; Rao et al., 2002; Vázquez-García, 2018) and in subject specific physiology courses (Cortright et al., 2003).
- Given the knowledge retention and learning requirements of this new integrated course design, the author sought to assess the use of collaborative-group exams to achieve the goals listed above.

Methods

Individual and Collaborative Exams

- Nineteen (19) students enrolled in Human Anatomy and Physiology I took part in this initial study.
- The students first completed the regularly scheduled course exams individually. The next day the students completed the exact same exam in pre-assigned groups of three to four students.

Final Exam Assessment

- The cumulative final exam for this course included subsets of questions which assessed the following:
 - Unit 4 (New information acquired after Unit 3)
 - Details from Units 1-3 (Cumulative Review)
 - Integrated information from Units 1-4
- The goal of the integrative question subset was to assess learning, application, and knowledge retention over the course of the semester.

59% Objective

55% Unit 4 (New Information)
21% Details (Review Units 1-3)
24% Integrative (Units 1-4)

41% Free Response

41% Unit 4 (New Information)
20% Details (Review Units 1-3)
39% Integrative (Units 1-4)

- Following the final collaborative exam the students completed a survey which assessed their *perceived* learning, knowledge retention, peer-to-peer teaching experience, and feelings towards group work.

This study was approved by the Centenary College Institutional Review Board. Protocol #18-002, Scholarship of Teaching and Learning Umbrella 2018-2019, Biology Department.

Results

Figure 1: Student performance on individual vs. collaborative exams. Student performance on the collaborative exams was significantly better than the individual exams. (A) $75.9 \pm 13.3\%$ vs. $90.4 \pm 2.8\%$, $p < 0.001$. (B) $80.3 \pm 15.9\%$ vs. $93.3 \pm 4.4\%$, $p < 0.01$. (C) $78.5 \pm 12.4\%$ vs. $89.0 \pm 3.7\%$, $p < 0.01$. Data represented as mean \pm SD (n=19); Paired-t-test.

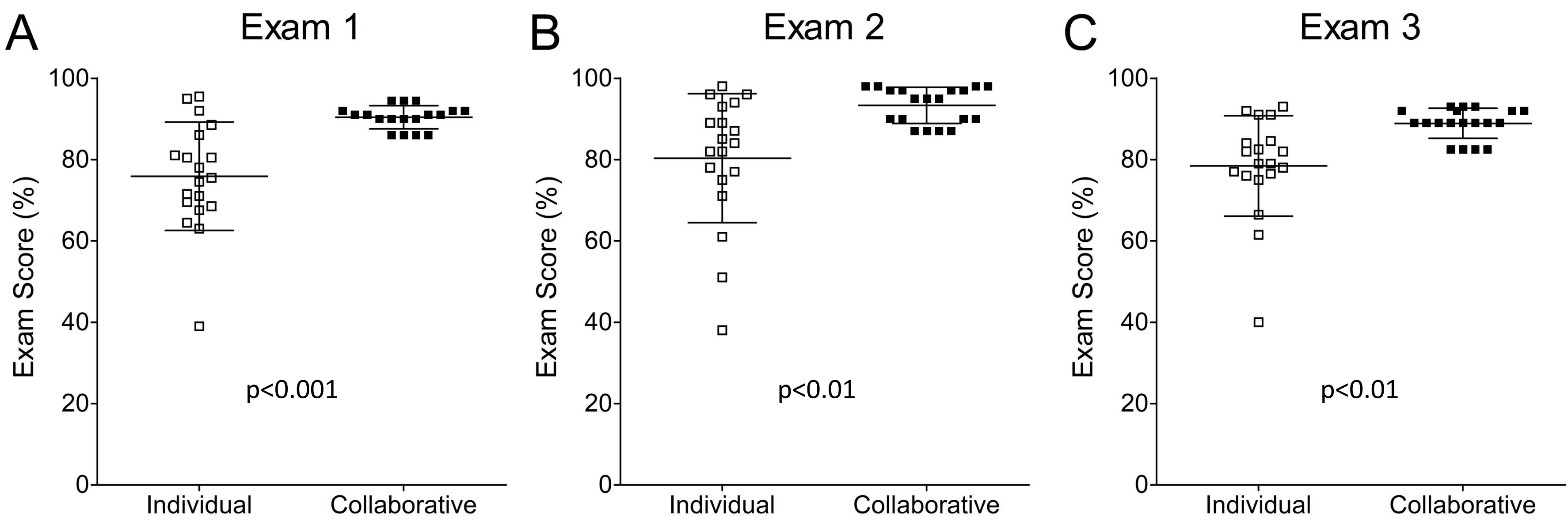
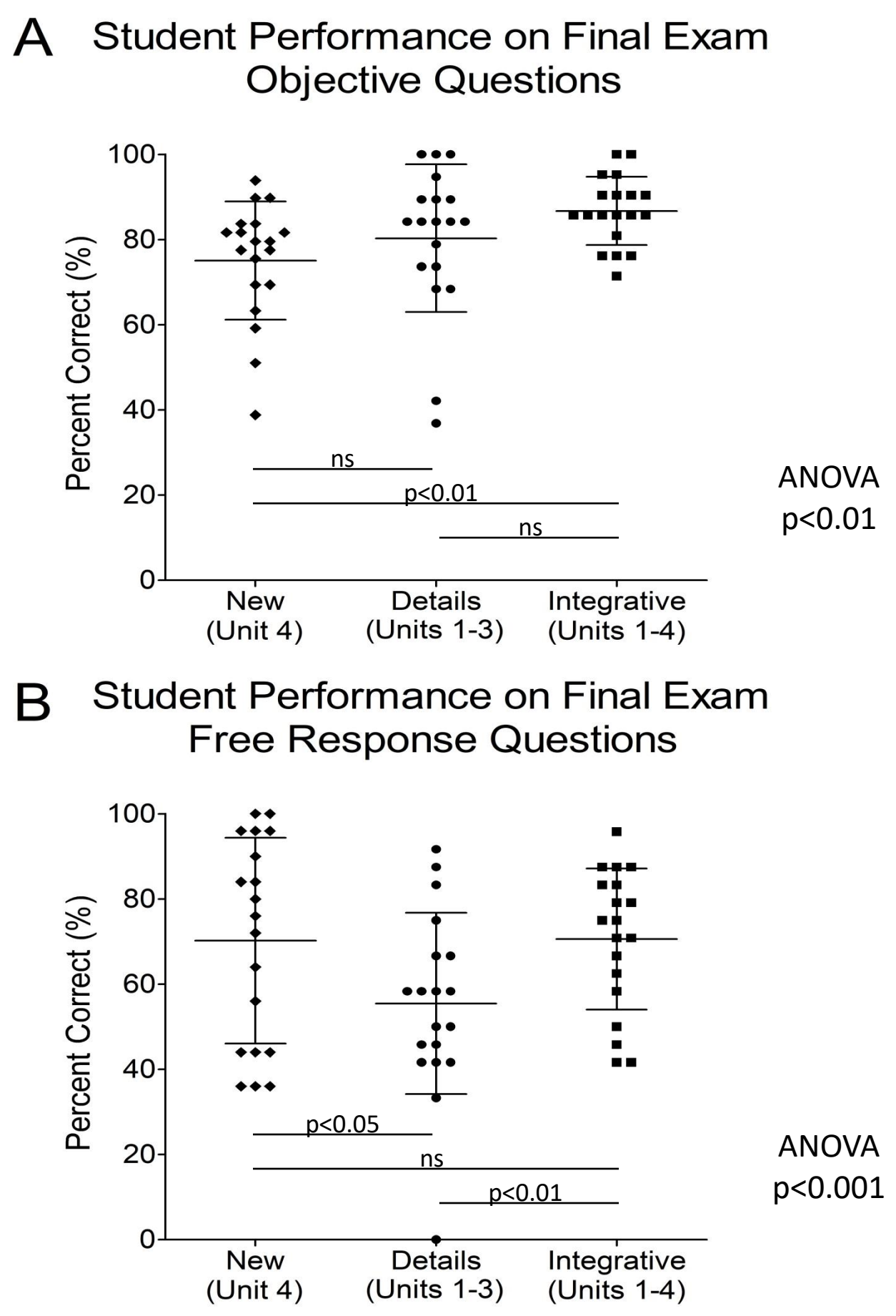


Figure 2: Summary of individual student survey responses. The survey asked the student to evaluate the following statements using a standard Likert scale where 1 indicated “strongly disagree” and 5 indicated “strongly agree”. Statements are organized in this figure by category. They were not presented in this order to students. (n=19)

	strongly disagree	somewhat disagree	neutral	somewhat agree	strongly agree
I enjoyed discussing the exam material with my peers during the collaborative exams.	5.3%	10.5%	10.5%	63.2%	10.5%
I enjoyed learning from my peers during the collaborative exams.	10.5%	0.0%	21.1%	42.1%	26.3%
The collaborative exams support the practice of group studying and collaborative thinking.	5.3%	5.3%	21.1%	42.1%	26.3%
After the collaborative exam, I often better understood the exam material.	5.3%	5.3%	0.0%	52.6%	36.8%
The collaborative exams reinforced the course material and/or major learning objectives.	5.3%	0.0%	0.0%	63.2%	31.6%
The collaborative exams helped me retain information throughout the course.	0.0%	0.0%	10.5%	68.4%	21.1%
When preparing for an exam, I often study on my own.	5.3%	0.0%	10.5%	15.8%	68.4%
When preparing for an exam, I often study with others in a study group.	42.1%	31.6%	10.5%	10.5%	5.3%
I looked forward to the collaborative exams.	15.8%	10.5%	42.1%	15.8%	15.8%
The collaborative exams enhanced my feelings toward group work.	5.3%	15.8%	47.4%	21.1%	10.5%
I feel that participation of group members was relatively equal.	5.3%	15.8%	5.3%	31.6%	42.1%
I think that the collaborative exams are a valuable learning activity.	0.0%	0.0%	10.5%	52.6%	36.8%

Figure 3: Final exam assessment. Individual student performance on the three subsets of final exam questions are compared below for both the objective (A) and free response (B) questions. Data represented as mean \pm SD (n=19); Repeated measures ANOVA, with Tukey’s post hoc test.



Conclusions

- Students performed significantly better on the collaborative-group exams, supporting the benefits of group problem solving and discussion.
- Collaborative-group exams were rated highly by the students in terms of peer-to-peer teaching, collaborative learning, and knowledge retention.
- The final exam assessment suggests that students improved throughout the course specifically on the topics that were integrative in nature.