A Curricular Exercise: Training Medical Students to Answer Layman's Questions
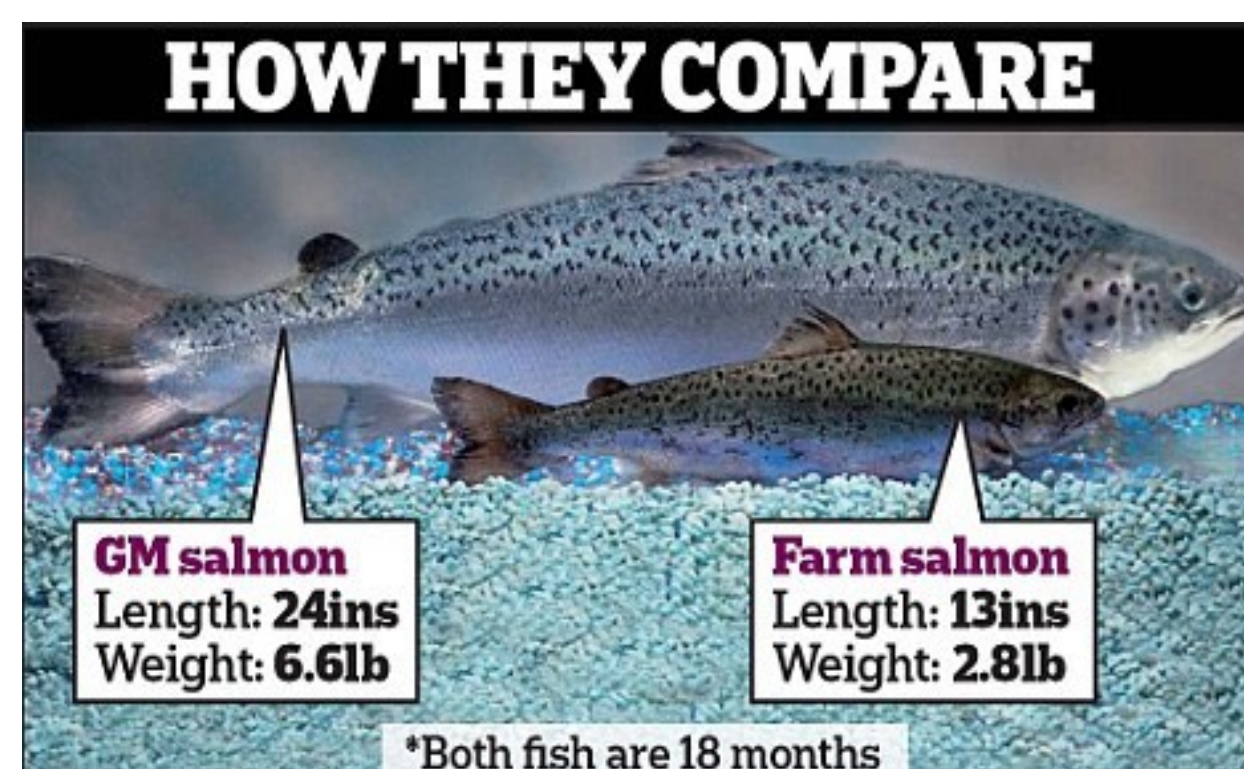
Jana M. Simmons[a] and Raquel P. Ritchie[b]

Department of Biochemistry and Molecular Biology, [a]College of Human Medicine, [b]College of Osteopathic Medicine, Michigan State University

Introduction

This project proposed to develop exercises in the medical school curriculum with two major educational objectives: (a) provide opportunity for students to practice integrating scientific and clinical knowledge to answer layman's questions; and (b) enhance the student's understanding and retention of scientific knowledge content. The project was initially tested in the form of an exercise in which students were asked to answer a patient's query: whether it is safe to eat genetically modified salmon (GM salmon). We hypothesized that when students take complex knowledge and internalize it enough to put it into their own words and explain it to someone else, they will retain that knowledge better than when it is studied in the traditional way of reviewing the knowledge in the professor's words (as originally delivered). The dual benefit for the students is that they are getting practice in a skill that will be useful to them in their future career.

The Homework Assignment

HOW THEY COMPARE

GM salmon
Length: **24ins**
Weight: **6.6lb**

Farm salmon
Length: **13ins**
Weight: **2.8lb**

*Both fish are 18 months

A patient, new to your practice, comes in for a routine annual check-up. As a part of the annual physical, you order the usual panel of blood tests. At the end of the visit the patient pulls out a piece of paper with the picture shown above and says, "Doctor, can I safely eat the genetically modified salmon?"

You indicate to the patient that you would need a considerable amount of information on the genetically modified (GM) salmon before you can respond. You tell the patient that: (a) you will attempt to learn about the GM salmon; and (b) you will discuss this during the next scheduled visit to go over the results of the blood tests.

Information regarding the GM salmon is provided during the Course, appropriate for the topic under consideration. Interested students are welcome to look up detailed information behind the science at: http://www.biofortified.org/2010/10/salmon/

You will be assigned one of five patient categories based upon your student number: Grocer, Lawyer, Retired Physician, Stay-at-home Dad, or Female Truck Driver.

Articulate a response appropriate to your patient.
Your patient is the intended audience; make sure you answer his/her question. A key objective of this exercise is to develop the ability to integrate and synthesize basic science knowledge in order to answer questions from patients (different categories in a general population) in a way that they can understand and engage. Be sure to keep in mind: (a) don't lose them in the language or detail; and (b) don't make them feel intimidated or belittled for their question(s).

Your response should include: (a) At the DNA level, how do the GM and Farm salmon differ and what results, biochemical and physiological, from this difference? (b) Is there a difference in the proteins produced by the GM and Farm salmon? (c) Will there be a significant difference in the type or amount of components (carbohydrate, lipid, protein, etc.) absorbed through the gut if your patient consumed a six-ounce filet of the GM versus Farm salmon? (d) Are there other issues or precautions that your patient needs to consider? For example, is there an increased risk to the consumer due to the method of DNA introduction or the presence of the modified gene product in a fish fillet?

The expectation is that students will spend no more than three hours on this assignment.
Limit your response to ~300 words (or about half of a single-spaced page).

Timing and Context Within the Basic Science Curriculum

- **College of Human Medicine:**
  Year 1, Semester 1,
  Biochemistry course completed; Mid-molecular biology and genetics course.
  ~200 students/year at 2 campuses (100 each East Lansing and Grand Rapids).

- **College of Osteopathic Medicine:**
  Year 1, Semester 2,
  Biochemistry and molecular biology course completed.
  ~300 students/year at 3 campuses (200 in East Lansing, 50 at Detroit Medical Center, and 50 at Macomb University Center).

- **Grading Method:**
  - Five faculty members on the instructional teams of the two medical schools.
  - Example essays were generated by faculty for each patient category (e.g. grocer).
  - When in doubt, a student's response was "flagged" for reading by all involved faculty and a consensus score was assigned.

Homework Assignment Grading Data

Zero Points 2%
One Point 0%
Two Points 0%
Three Points 16%
Four Points 82%
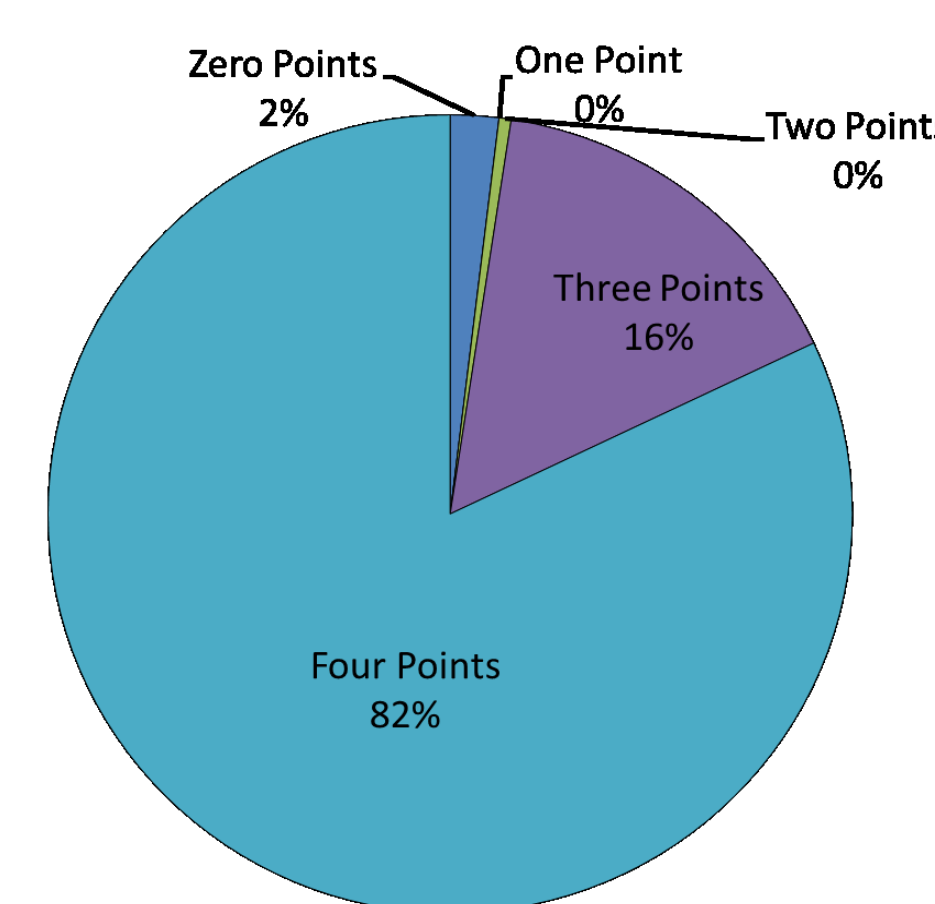
These data represent the scores for the 2013 homework assignment and are similar to data collected in other years from both colleges.

Example of grading rubric:
1 point: for responding explicitly to the patient's 'yes or no' question?

1 point: for explaining the molecular biology (e.g. recombinant gene and promoter)

1 point: for explaining the biochemical aspects (e.g. results of digestion and absorption of fish filet, in terms of the amino acid, carbohydrate, and lipid composition)

1 point: for pitching the response appropriate for the patient (retired physician; grocer) and for mentioning additional factors (method of introducing the recombinant DNA by physical microinjection rather than viral delivery; allergy to wild-type salmon versus GM salmon, etc.)

Assessment on Retention of Scientific Content

Two sets of exams:
- **pre exercise** (before the homework assignment)
  529 students across both colleges
- **post exercise** (One month after the pre-exercise examination)
 527 of the same students

Two Question Categories
- **Project Question** (tested key concepts reinforced by the assignment)
- **Control Question** (tested concepts covered in the course, but not explicitly reinforced by the homework assignment)

Aggregate performance on those questions was assessed to determine the overall retention of concepts and the retention of the specific concepts reinforced by the homework assignment over the same time period. Statistical analysis was performed using a model to compare two population proportions as described by D. J. Rumsey.

http://www.dummies.com/how-to/content/how-to-compare-two-population-proportions.html

Assessment Results for College of Human Medicine
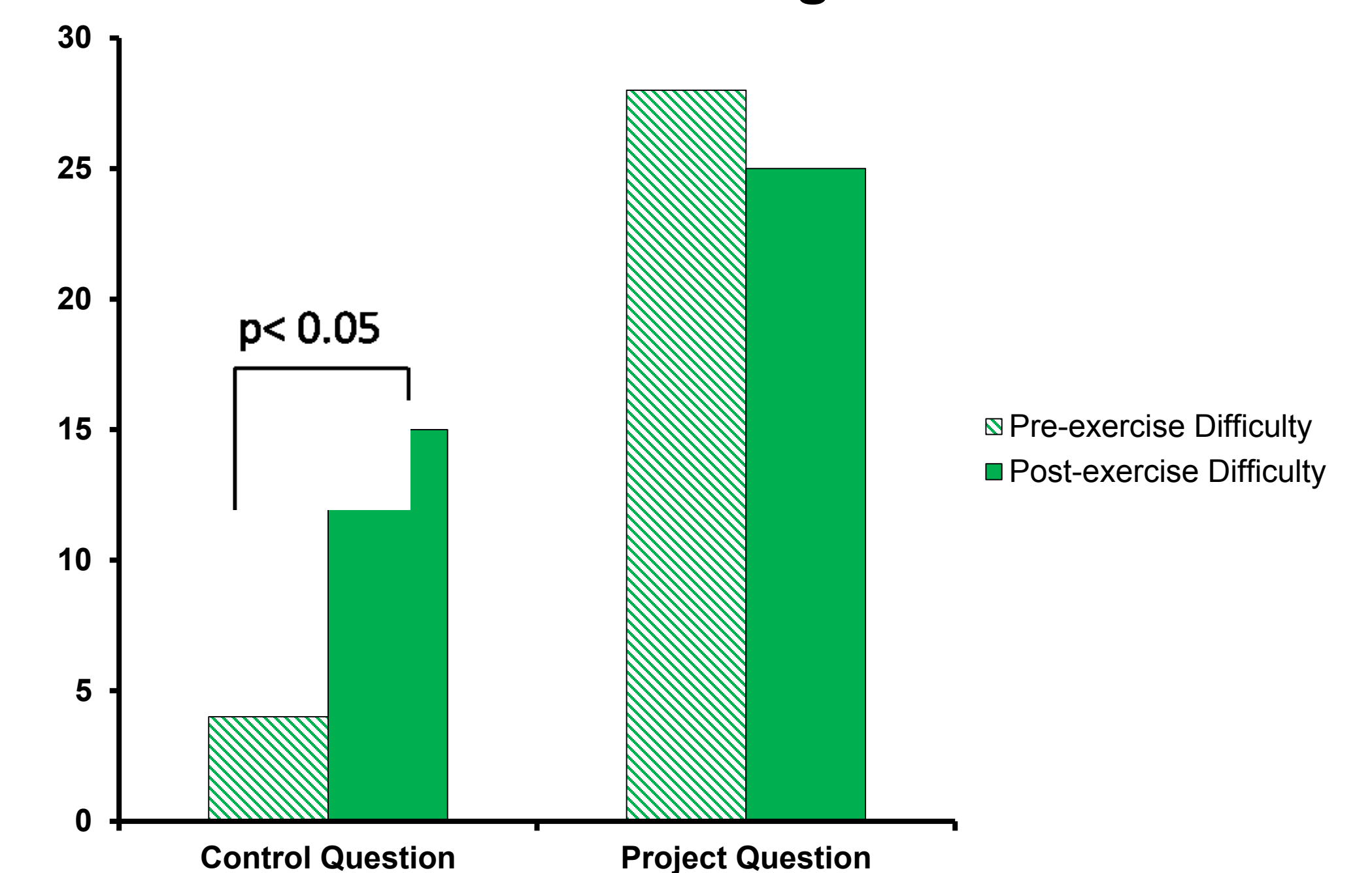
p < 0.05

Pre-exercise Difficulty
Post-exercise Difficulty

Control Question   Project Question

Difficulty reflects the percentage of students answering the question incorrectly. A significant difference was observed in the difficulty of the control question pre- versus post exercise.

Assessment Results for College of Osteopathic Medicine
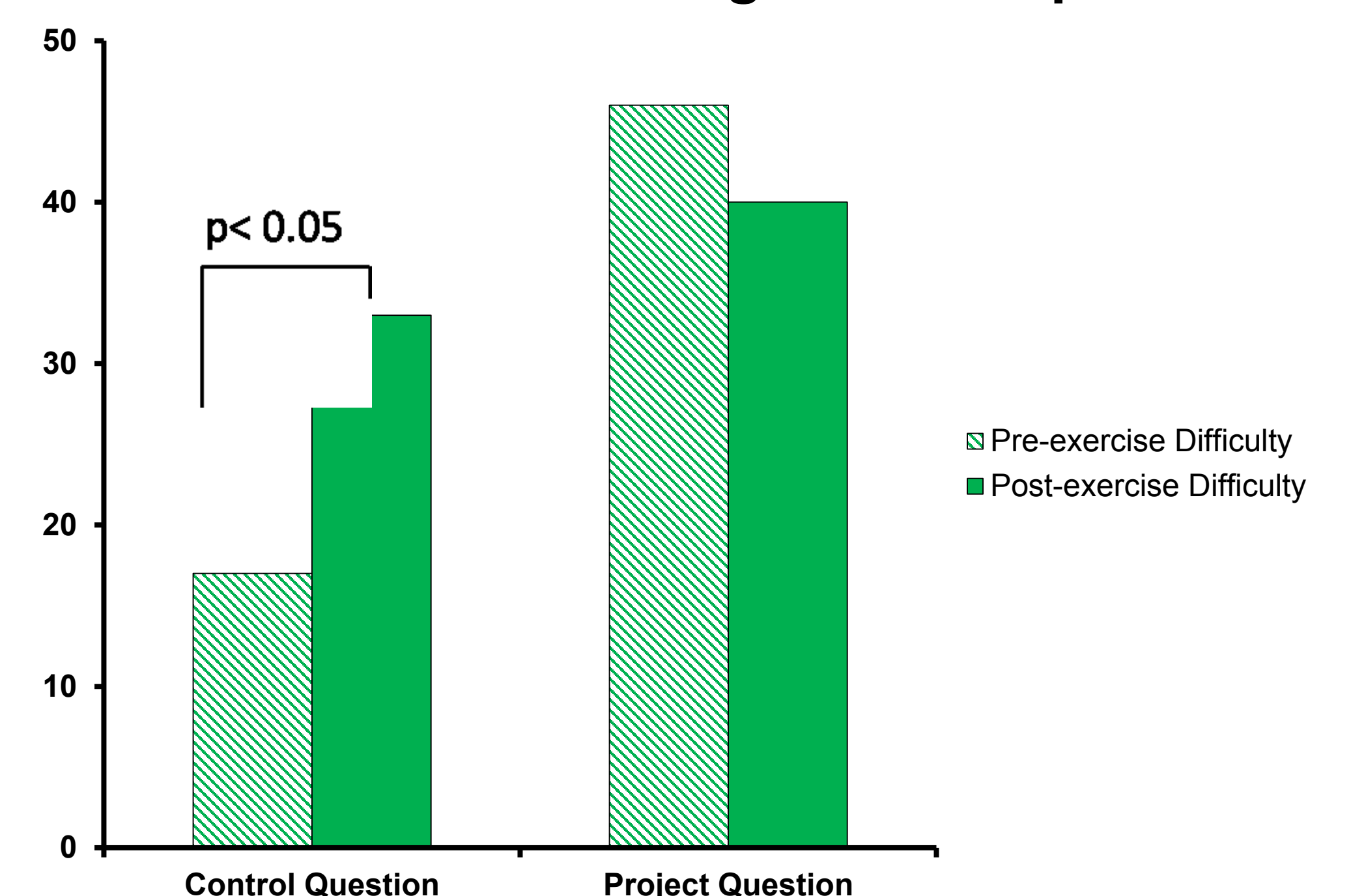
p < 0.05

Pre-exercise Difficulty
Post-exercise Difficulty

Control Question   Project Question

Difficulty reflects the percentage of students answering the question incorrectly. A significant difference was observed in the difficulty of the control question pre- versus post exercise.

Conclusions

We observed a significant increase in difficulty of the control questions (~14% across both colleges) while the project questions exhibited no significant change in question difficulty. This suggests that the GM salmon assignment aided students in internalizing the concepts and transferring them form temporarily memorized ideas to longer term knowledge that could be applied to new problems in the future.

These results are consistent with the literature showing that passively obtained bits of information are easily lost over time. (Rico 1981, D'Eon 2006) A well-studied principle in learning is that of self-explanation, coined by Michelene T. H. Chi, which posits that "people learn more deeply when they spontaneously engage in or are prompted to provide explanations during learning". (Chi 1994)

- Chi, M. T. H., deLeeuw, N., Chiu, M. H., Lavancher, C. (1994) "Eliciting self-explanations improves understanding." *Cognitive Science* 18: 439-477
- D'Eon, MF (2006) "Knowledge loss of medical students on first year basic science courses at the University of Saskatchewan." *BMC Medical Education* 6: 5
- Rico, E., Galindo, J., Marset, P. (1981) "Remembering biochemistry: A study of the patterns of loss of biochemical knowledge in medical students." *Biochemical Education* 9: 100-102