

# Class-Directed Undergraduate Research Maintains Universal Experience for all Science Graduates

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## ABSTRACT

Undergraduate research is a defining characteristic of the science programs at Florida Gulf Coast University. Historically, students established a mentor/ mentee relationship with a single faculty member and research occurred during a student's senior year. This design worked beautifully while FGCU was a small. Maintaining this type of undergraduate research requirement has become increasingly difficult as the university and departments have grown rapidly (2200 to > 12,000 in 14 years).

At FGCU we developed research classes to fulfill the undergraduate research requirement. A single faculty member teaches each course and develops 3 – 5 projects. Students conduct the research in semester-long collaborations in small groups. We hope creation of senior research classes will allow us to maintain our tradition of mentor/ mentee relationships for the most motivated students while providing all students with a quality undergraduate research experience.

## INTRODUCTION

Undergraduate research is a foundational experience for both students and faculty in the science programs at Florida Gulf Coast University (FGCU).

Undergraduate research began with the school's founding as faculty sought to enhance their scholarship at a primarily undergraduate institution. From the onset, undergraduate research at FGCU was represented by intimate mentor-mentee collaborations between a faculty member and an individual student.

### Research Curriculum

To ensure student success, the Departments of Biological Sciences as well as Marine and Ecological Sciences created three linked courses that introduced students to scientific research.

- 1. Scientific Process<sup>1</sup>:** This course taught juniors how to ask a question, develop an associate argument, and construct a viable methodology in the creation of a research proposal.
- 2. Senior Research:** Students were then required to conduct a semester-long research project during the first half of their senior year. Students gained intimate knowledge about the scientific process while fostering a long-term relationship with a professor. This design worked beautifully while FGCU was a small school.
- 3. Senior Presentation:** Students in the final semester of their undergraduate career learned how to communicate their findings to both a scientific and non-scientific audience.

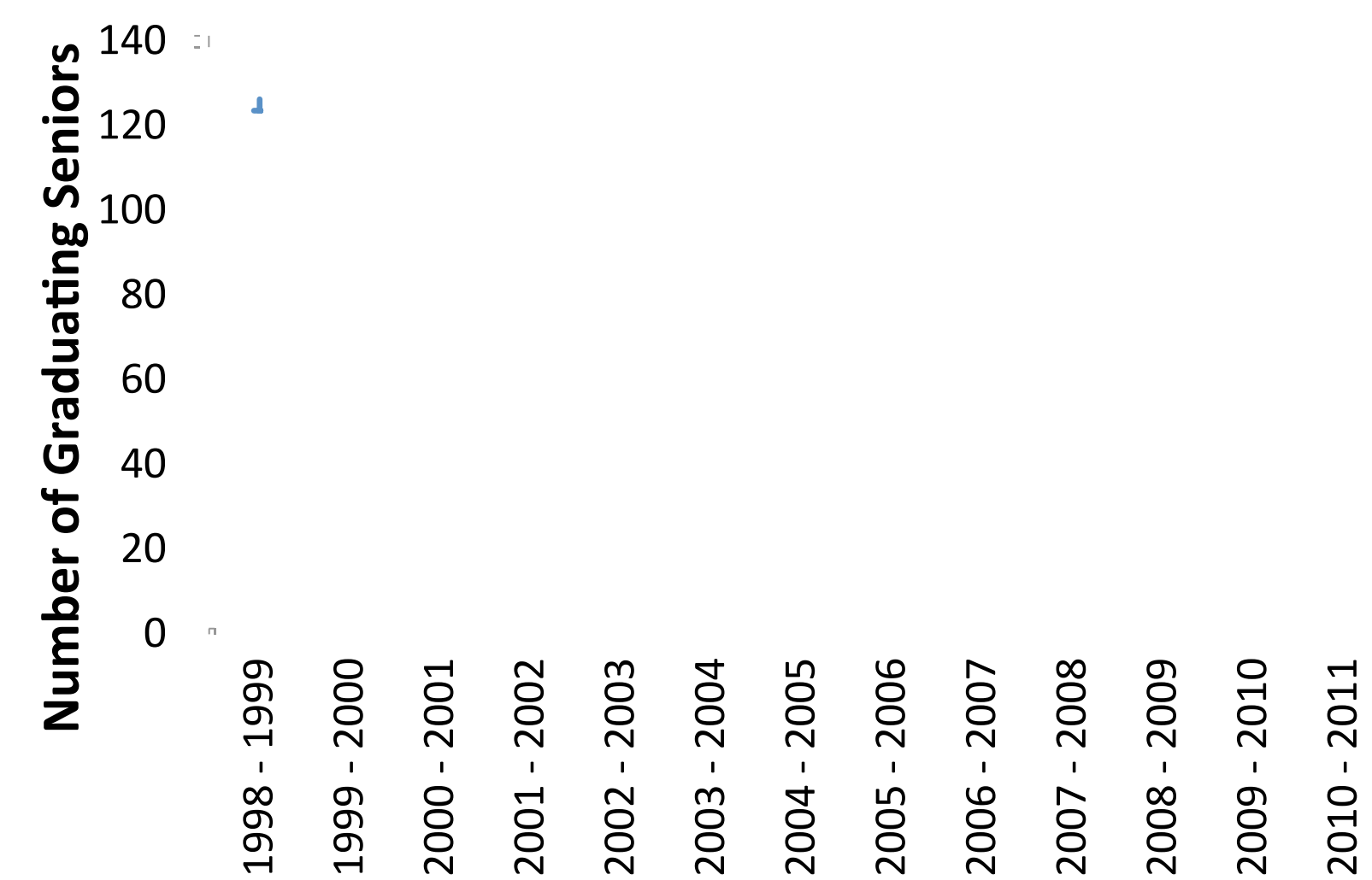


Figure 1: Number of graduating science students.

### Undergraduate Research for All

Since the school was found in 1997, the number of students graduating from science programs has shown explosive growth (Figure 1). Our ability to ensure universal access to a high-quality undergraduate research experience has required curricular revisions.



## Class-Directed Undergraduate Research

To ensure universal access to a high-quality undergraduate research experience, faculty members from Biology and Environmental Studies choose to develop class-based undergraduate research experiences independently. In both cases, we developed a research course that integrated scholarship into a traditional class format. We are now experimenting with alternative models where the research experience objective is met through the implementation of class-based collaborative projects (Table 1).

Biology	Environmental Studies
Class-based research students only (mentored students with faculty)	Combines mentored and class-based research students
Class-based progress during weekly presentation	Individual update with faculty
Rigorous weekly Peer-review	Minimal Peer-review
Constrained Approach	Constrained System
Focuses on single discipline (i.e. Behavioral Ecology)	Focuses on a single system (i.e. long-term forest plot)
Anti-predator display of ringed-neck snake (field experiment)	Forest Growth Plots (Ecological Field Study)
Butterfly Community Dynamics (field observation)	Forest Growth Policy – Carbon Markets (Environmental Policy Development)
Kleptoparasitic dewdrop spiders (field observation)	Forest Growth Education (Environmental K-12 Education)

Table 1: Alternative approaches to the implementation of class-directed undergraduate research in Biology and Environmental Studies.

## Pre- and Post-Experience Surveys

Pre- and Post-Experience Surveys were used to assess student perception as well as each student's evaluation of her or his own research and academic learning gains. Survey questions used slider bar in Checkbox<sup>®</sup> to quantify students' response without the limitations associated with traditional Likert-scale survey questions. We used one-way permutation tests to compare the different approaches used in Biology and Environmental Studies. We also used one-way permutation tests students' pre and post self-evaluations.

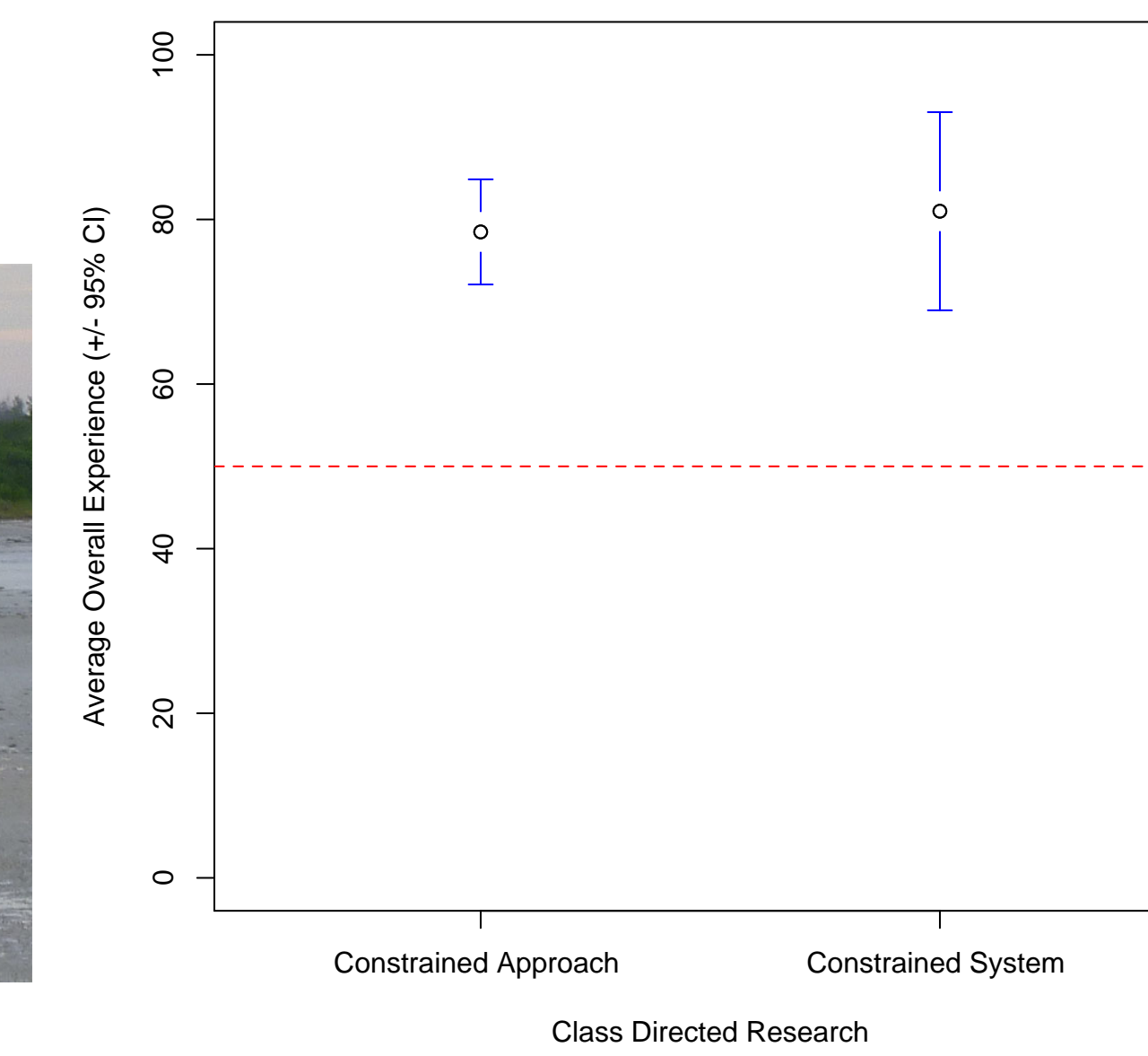


Figure 2: Students rated the overall quality of the experience highly.

In addition, students described similar high-quality in either the approach used in Biology or Environmental Studies. (Z = 0.323, p = 0.755)

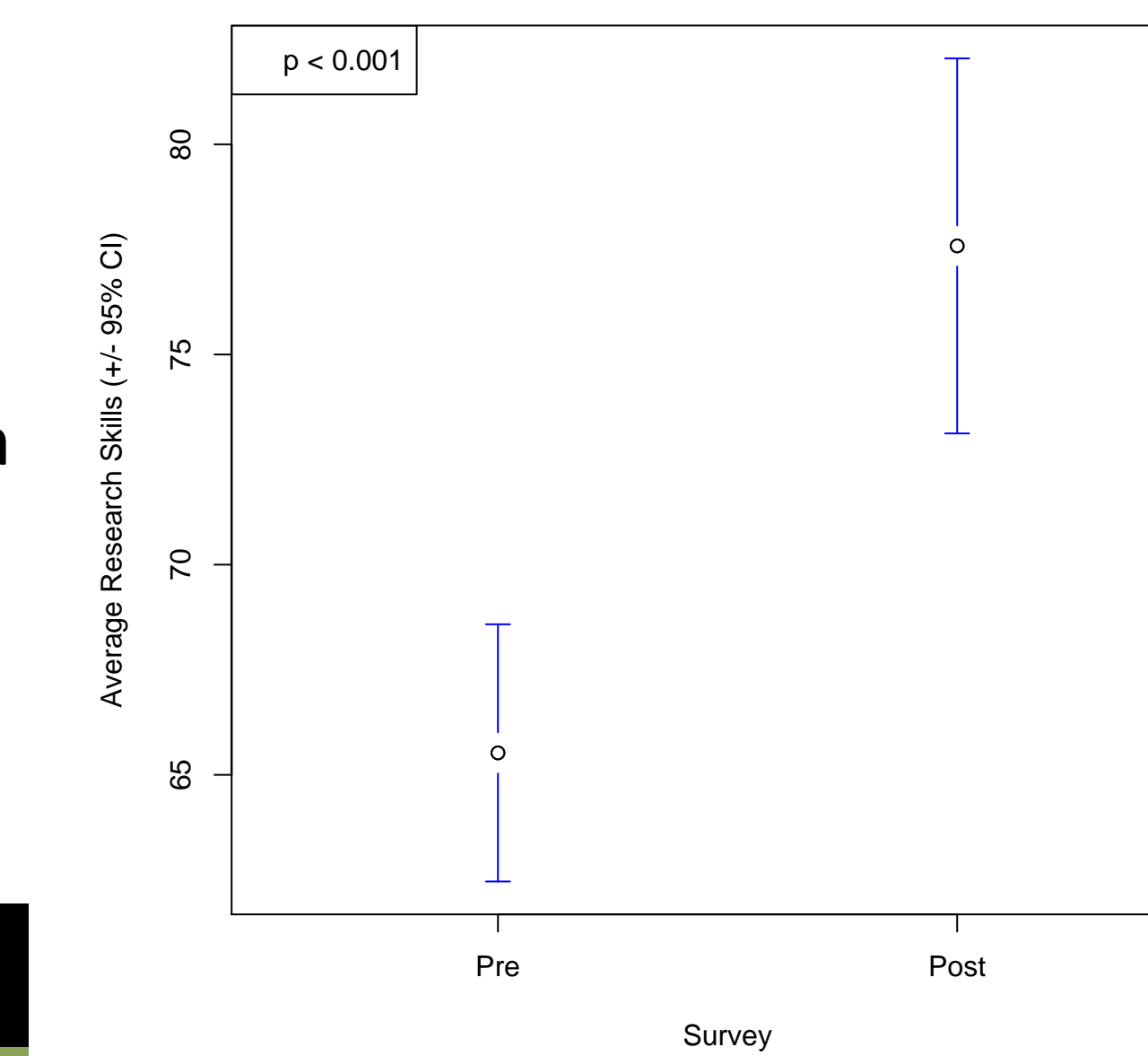


Figure 3: Students rated their overall research skills more highly after the experience. (Z = 4.134, p < 0.001)

Research skills included the ability to develop and carry out a project, use the primary literature, as well as analyze and interpret results.

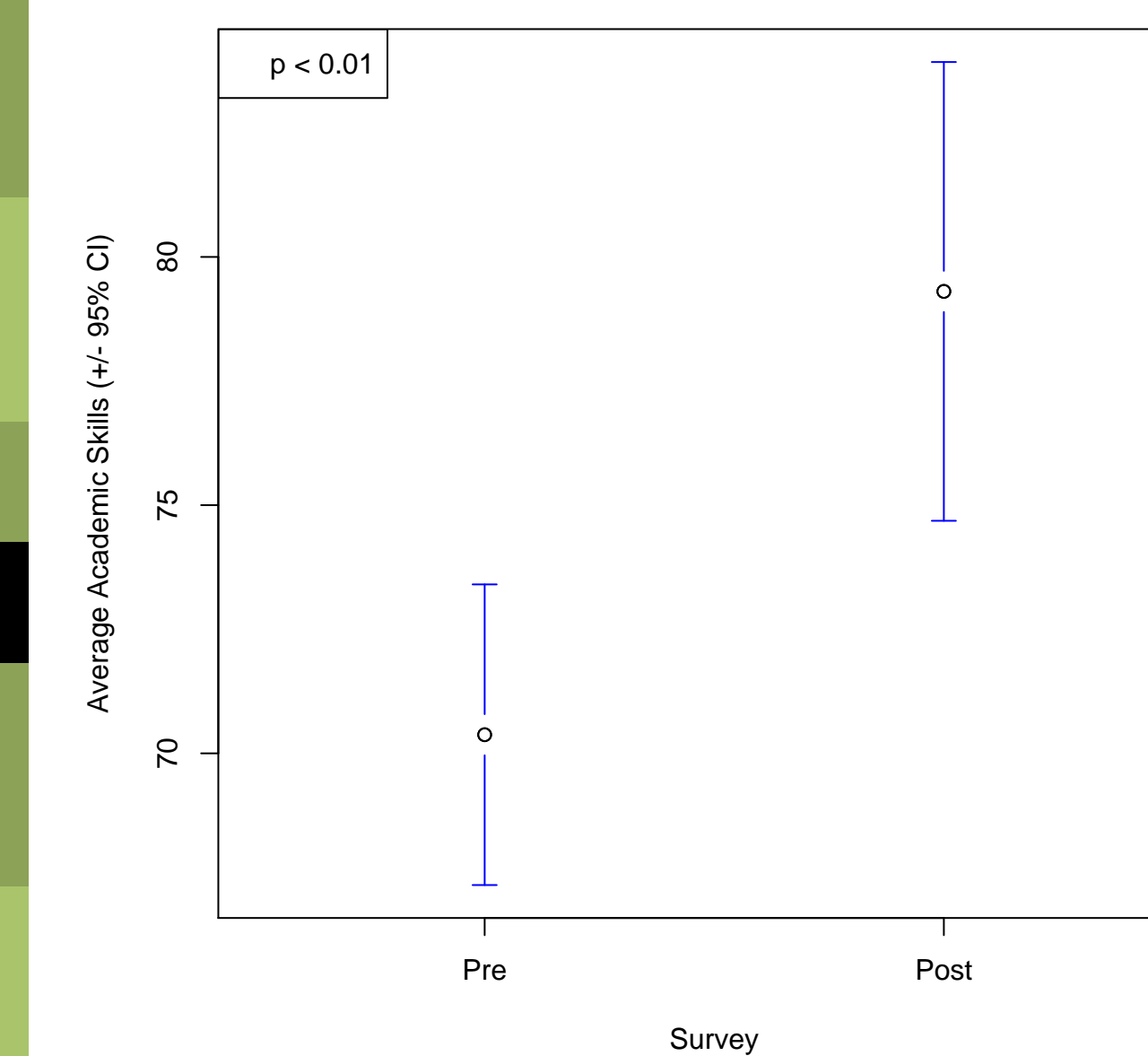


Figure 4: Students assessed their own academic skills more highly after the experience. (Z = 3.145, p = 0.001)

Academic skills included problem solving, critical thinking, ethical evaluation, writing, and speaking.

## Developing the Next Step

Universal access to a high-quality research experience is at the core of what makes Florida Gulf Coast University, FGCU. We firmly believe that all science students must learn how to conduct meaningful science in order to graduate. Development of class-directed undergraduate research is critical to the preservation of meaningful undergraduate research experience for students. Implementation of the experience requires continuous modifications, as the experience has proven highly popular with students; sections of these courses have grown from 19 students to 52 students in 3 years.

## Literature

1 - Meers, M.B., Demers, N.E., and Savarese, M. 2003. Integrating scientific philosophy, theory, methods, and ethics in undergraduate science curricula. *Journal of College Science Teaching*. 33(3): 34-39