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ABSTRACT

Del Mar College (DMC) is a two-year Hispanic and Minority Serving Institution that is revising science education with authentic Discovery-Based Undergraduate Research Experiences. The course-based research has created a new program for South Texas and incorporated innovative pedagogical approaches, developed educational materials, provided students with real-world research experiences, and provided professional development of educators. The project addresses the pedagogical challenges in STEM education and provides assessment data for discovery-based undergraduate research. The pedagogical issues that fit in a larger national context calling for striking improvements in STEM education. There is an expanding body of literature demonstrating that STEM majors are lost not because of talent but due to the way they are taught. The growing understanding of evidence-based learning points to new ways in which pedagogies can be changed to improve student achievement and retention. Topics also address the challenges and resolutions of implementing discovery-based undergraduate research. The goals are to recruit and retain more STEM students especially those from underrepresented groups. This work also addresses the outcomes of these assessment efforts and the implications for future STEM research and practice. For example, STEM curricular changes that increase persistence in undergraduate students are linked with specific psychometric parameters such as project ownership. Another benefit of authentic research is that it integrates a competency-based testing of laboratory techniques. For example, students that do not use proper aseptic technique will experience contamination and will have to repeat their experiments. Therefore, assessment data will be presented that specifically measures persistence in the sciences.

FALL

BIOL 1406: Biological Concepts I, BIOL 1414: Intro to Biotechnology I Phage Isolation & Characterization



WINTER BREAK

Genome Sequencing at University of Pittsburgh

SPRING

BIOL 1407: Biological Concepts II, BIOL 1415: Intro to Biotechnology II Genomic Analysis/Annotation (in joint computer lab sessions)

DMC Students working in the laboratory:



CURE Book chapter, Stylus Publishing, Sterling, VA

COURSE-BASED UNDERGRADUATE RESEARCH
Educational Equity and High-Impact Practice

Edited by **NANCY H. HENSEL**
Foreword by **CARY R. DAVIDSON**

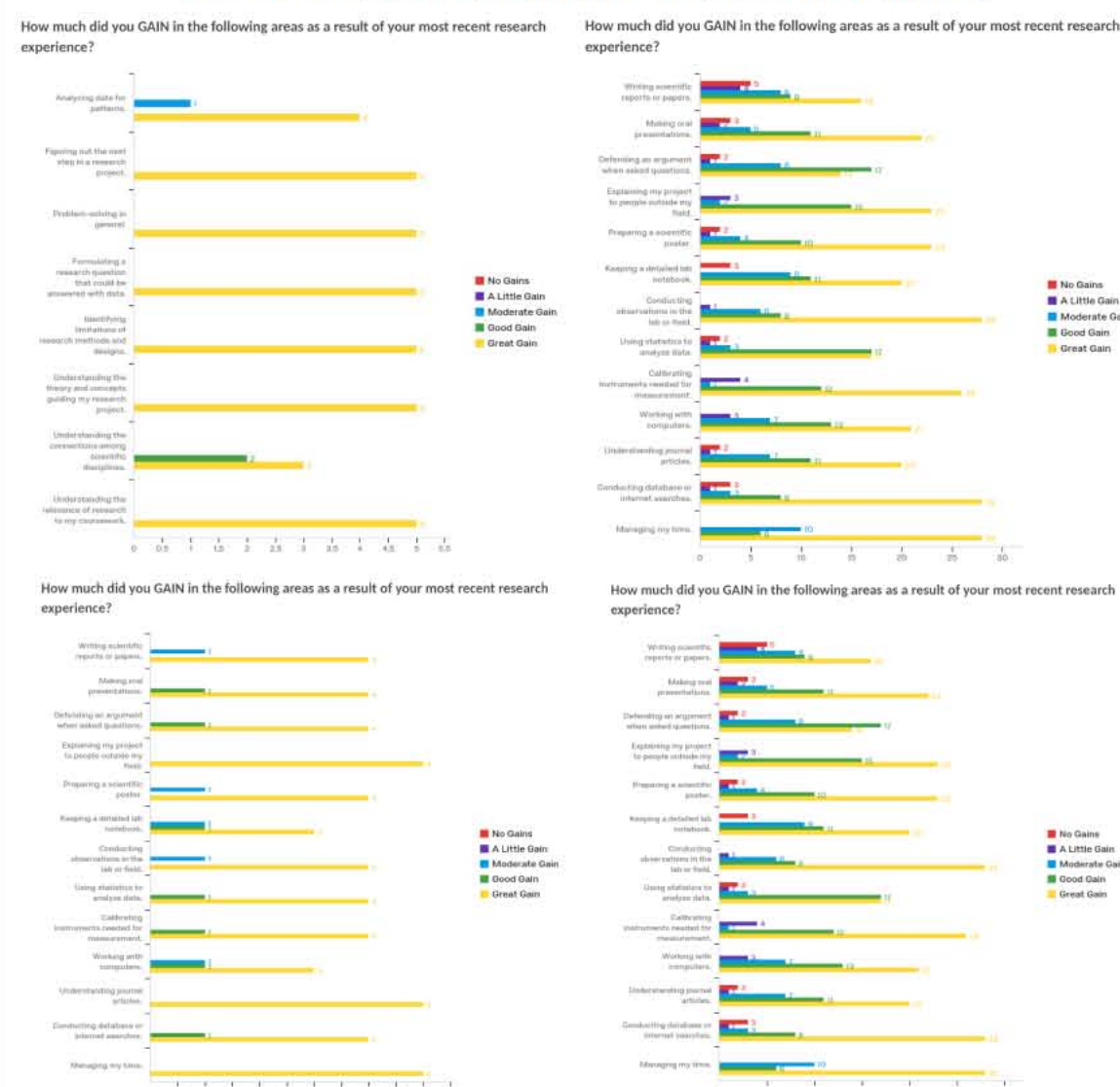
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STUDENT OUTCOMES AND IMPACTS OF DISCOVERY-BASED RESEARCH IN THE FIRST TWO YEARS OF UNDERGRADUATE EDUCATION

Del Mar College (DMC) is a two-year Hispanic and Minority Serving Institution that is revising science education with authentic Discovery-Based Undergraduate Research Experiences. The course-based research has created a new program for South Texas and incorporated innovative pedagogical approaches, developed educational materials, provided students with real-world research experiences, and provided professional development of educators. The project addresses the pedagogical challenges in STEM education and provides assessment data for discovery-based undergraduate research. The pedagogical issues that fit in a larger national context calling for striking improvements in STEM education. There is an expanding body of literature demonstrating that STEM majors are lost not because of talent but due to the way they are taught. The growing understanding of evidence-based learning points to new ways in which pedagogies can be changed to improve student achievement and retention. Topics also address the challenges and resolutions of implementing discovery-based undergraduate research. The goals are to recruit and retain more STEM students especially those from underrepresented groups. This work also addresses the outcomes of these assessment efforts and the implications for future STEM research and practice. For example, STEM curricular changes that increase persistence in undergraduate students are linked with specific psychometric parameters such as project ownership. Another benefit of authentic research is that it integrates a competency-based testing of laboratory techniques. For example, students that do not use proper aseptic technique will experience contamination and will have to repeat their experiments. Therefore, assessment data will be presented that specifically measures persistence in the sciences.

Background: Research shows evidence supporting, and each DMC student who has participated in the CURE program in the first two years of undergraduate education. The data is presented by comparing student outcomes at DMC to the national average.

DEL MAR COLLEGE URSSA PROGRAM RESULTS

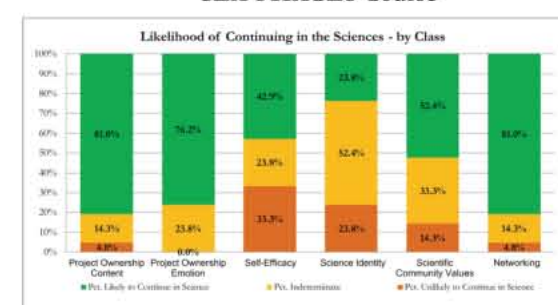


CCURI URSSA Survey Course Report-Del Mar College summer internship data is presented on the two left panels above. The other CCURI colleges are presented in composite on the above two right panels.

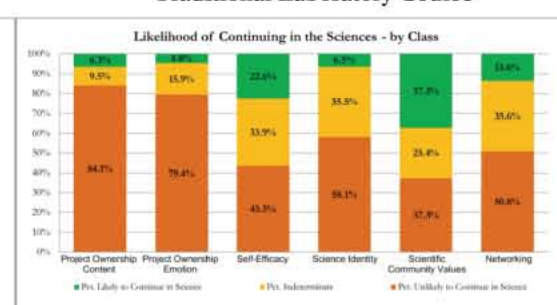
SEA-PHAGES PITS SURVEY: SIX PSYCHOMETRIC PARAMETERS

Variable	Relevance for Course
Project Ownership Content	Shows the degree to which a student is engaged and has a personal connection with their research. This is a good indicator of an authentic research experience.
Project Ownership Emotion	Indicates student's personal excitement with their research
Self-Efficacy	Indicates the degree to which students believe that they have the ability to perform scientific procedures and act as scientists.
Science Identity	Indicates student self-identification as a scientist. This is a good indicator of persistence.
Scientific Community Values	Indicates a student's acceptance of science values such as the idea that scientific knowledge is important. This is a good indicator of persistence.
Networking	Measures the degree to which students are talking about their research with other people in their personal, social and scientific communities.

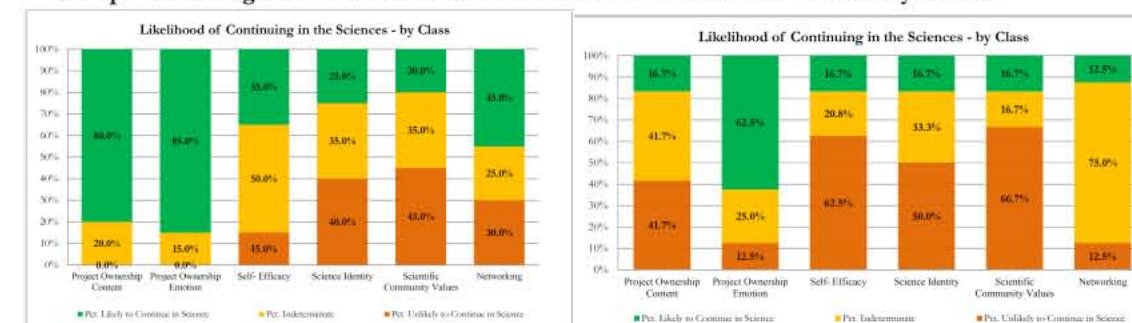
SEA-PHAGES Course



Traditional Laboratory Course



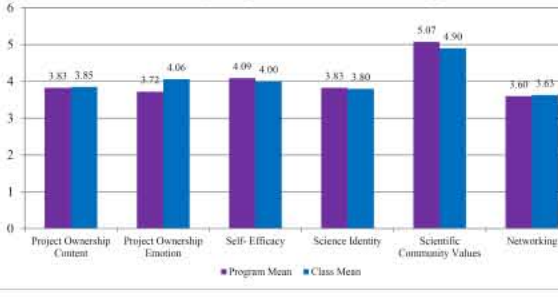
Comparison of Figure 2 for a SEA-PHAGES Course and a Traditional Laboratory Course



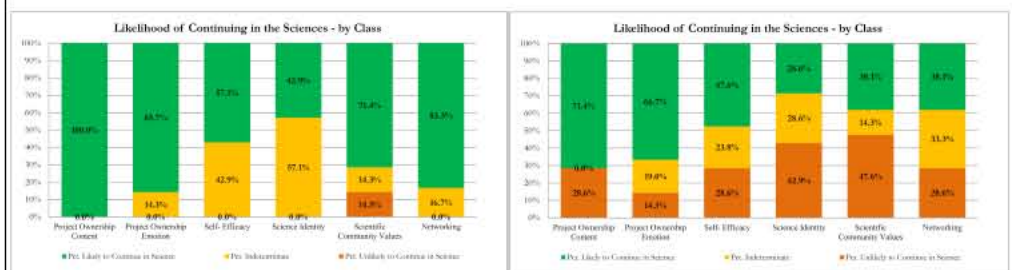
BIOL 1406 - Biology I (SEA-PHAGES): Surveys Completed: 20; Participation Rate: 83.3% of total enrollment, Fall, 2018

BIOL 1406 - Biological Concepts I (Biology for Science Majors I) TRADITIONAL: Surveys Completed: 24; Class Participation Rate: 100% of total enrollment, Fall, 2016

Means for 6 Psychological Measures: Class and Program

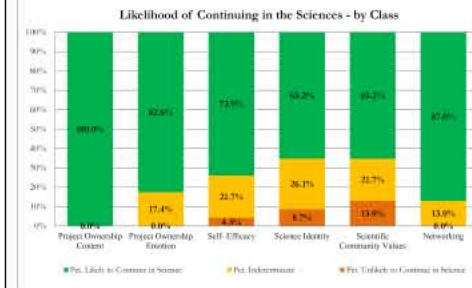


BIOL 1406 - Biology I (SEA-PHAGES): Surveys Completed: 13; Class Participation Rate: 54.2% of total enrollment, Fall, 2017

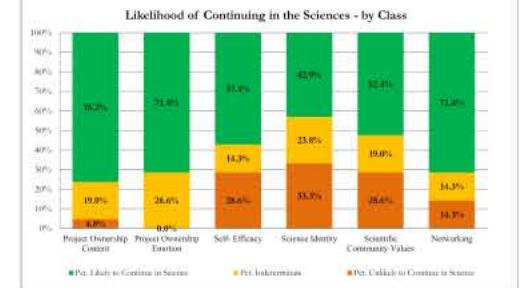


BIOL 1414 - Biotechnology I (SEA-PHAGES): Surveys Completed: 7; Class Participation Rate: 78% of total enrollment, Spring, 2016.

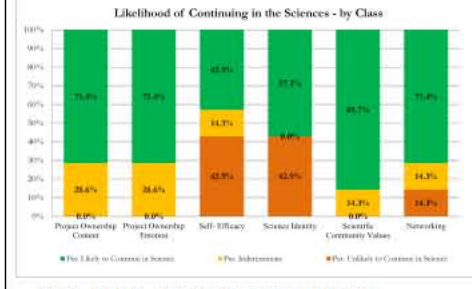
BIOL 1406 - Biological Concepts I (Biology for Science Majors I) - (SEA-PHAGES). Surveys Completed: 21; Class Participation Rate: 84% of total enrollment, Fall, 2016.



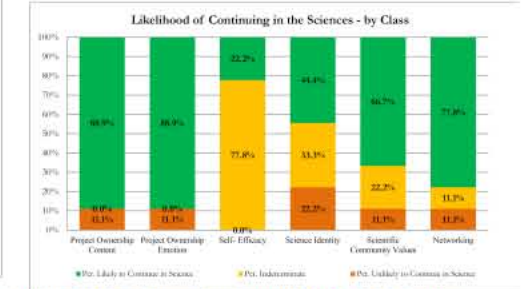
BIOL 2421 - Microbiology I (PARE): Surveys Completed 23; Class Participation Rate: 96% of total enrollment, Spring, 2017.



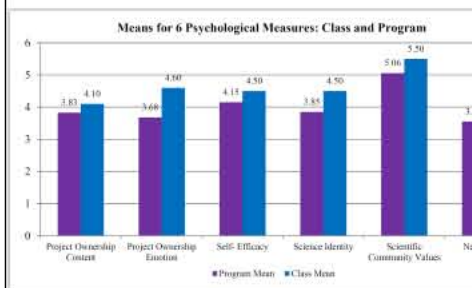
BIOL 1407 - Biological Concepts II (Biology for Science Majors) SEA-PHAGE: Surveys Completed: 21; Class Participation Rate: 87% of total enrollment, Spring, 2017.



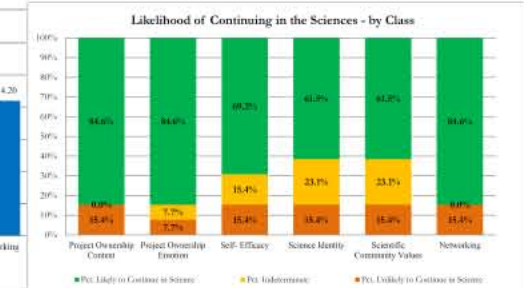
BIOL 1415 - Biotechnology II (SEA-PHAGES): Surveys Completed: 7; Class Participation Rate: 47% of total enrollment, Spring, 2017.



BIOL 1414 - Biotechnology I (SEA-PHAGES): Surveys Completed: 9; Class Participation Rate: 70% of total enrollment, Fall, 2017.



BIOL 1415 - Biotechnology II (SEA-PHAGES): Surveys Completed: 13; Class Participation Rate: 100% of total enrollment, Spring, 2018.



CONCLUSIONS AND FUTURE DIRECTIONS

- Implementing a CURE program is a significant strategy for improving undergraduate science education.
- Students are more motivated to pursue STEM degrees and careers.
- Students experience indisputable outcomes such as presentations, awards, publications, and summer internships.
- Persistence in the sciences is an outcome of CURE programs.
- The PITS Survey shows that discovery-based research may increase the likelihood of continuing in the sciences.

Reference

Hanauer DJ, Graham MJ, Hatfull G. A Measure of College Student Persistence in the Sciences (PITS). CBE Life Sci Educ 2016;15:1-10.



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