Increasing Student Persistence with Discovery-Based Research in the First Two Years of Undergraduate Education

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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 for 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

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 indesirable 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

 SEA-PHAGES PITS SURVEY: SIX PSYCHOMETRIC PARAMETERS

 Variable | Relevance for Course
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 Project Ownership Content | Shows the degree to which a student is engaged in 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 an indicator of persistence.
 Scientific Community Values | Indicates a student’s acceptance of scientific 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 vs. Traditional Laboratory Course

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

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