SUCCESS with an Undergraduate Science Research Course

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URE Type: Undergraduate Research Course STEM Focus: Multidisciplinary

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ABSTRACT

An NIH Institutional Research and Career Development (IRACDA) collaboration between Suffolk County Community College (SCCC) and Stony Brook University (SBU) led to the design and implementation of an online science research course, based on the SENCER approach in which students identify a civic problem and solve it through the application of STEM knowledge. The SENCER approach has also led to the modification of several science lab courses.

The online course asks students to apply scientific techniques to their ideas as they investigate today's dilemmas in areas such as energy, health and the environment. Students enrolled in this online research methods course were introduced to several aspects of scientific research, including networking with practicing scientists, thinking about ethics in the context of research, interpreting and analyzing statistics, and reviewing current literature topics in multidisciplinary STEM fields. This course empowers students while strengthening team communications and collaborations, peer reviewing and critiquing skills.

For an increasing number of community college science students doing summer research at various institutions, this course serves as a companion course for student research interns or as a means to accrue academic credits and research project experience. Students are empowered and enabled to further develop a range of transferable skills, particularly teamwork, oral communication, presentation skills, and scientific writing

Our findings indicate that community college student researchers perform better academically than their peers who chose a more traditional path, and that success in STEM encourages increased persistence of underrepresented populations in college and beyond to STEM careers or higher STEM education. Finally, the results of our research to date point to positive implications for the mentoring of our community college research scholars by our NIH IRACDA postdoctoral faculty and our prospective NSF Alliances for Graduate Education and the Professoriate (AGEP) teaching assistants.

RESEARCH QUESTIONS

We are exploring specific questions related to the online modality.

Does an online interdisciplinary research methods course focused upon authentic issues

- **assist students with their research ?**
- **enhance acquisition of transferable skills - teamwork, presentation skills and scientific writing skills?**
- **promote scientific inquiry and discourse?**

METHODOLOGY

Online Introduction to Research Methods Course

- **Developed for the Blackboard platform by SCCC faculty and an SBU IRACDA Teaching Fellow.**
- **Serves as a companion course for student research interns or for those who wish to get a flavor for methodologies and analytical tools used for a successful research project.**

- **Content**
  - **Introduction to various components of research including experimentation and quantitative/qualitative research methods.**
  - **Focus on health, climate change and sustainable energy solutions.**
  - **Statistical data analysis relevant to scientific data.**
- **Instructional strategies**
  - **Student-centered.**
  - **Online format to allow flexible work/research schedules.**
  - **Effective use of technologies to watch video lectures and analyze randomly generated experimental data.**
  - **Term paper aimed to build student confidence when using written and oral forms of presentation.**
  - **peer review and critique.**

WHY ONLINE LEARNING? WHY A RESEARCH COURSE?

Elements of online learning:

- **Learner relevance**
- **Active learning**
- **Learner autonomy**
- **Technology competence**

Ke, F. and Kwak, D. (2013). Constructs of Student-Centered Online Learning on Learning Satisfaction of a Diverse Online Student Body: A Structural equation Modeling approach. *Journal of Educational Computing Research* .

Rationale for a Research Course

- **Absence of advanced seminar or research course at SCCC.**
- **Absence of interdisciplinary STEM research course at SCCC.**
- **Increasing number of science students doing summer research at various institutions (national labs, academia, industry).**
- **Research component is missing from many science courses.**
- **Need to better prepare students to apply qualitative and quantitative analysis relevant to the wide range jobs they seek.**
- **Need to build presentation skill confidence in students.**

ITEM	Engaged Learning	Motivation
Generally, I am more engaged in my online courses.	0.84	
I have more opportunities to reflect on what I have learned in online courses	0.79	
Online learning helps me understand course material.	0.76	
There are more opportunities to collaborate with other students in an online course.	0.67	
My online experience has increased my opportunity to access and use information.	0.66	
I am more likely to ask questions in an online course.	0.65	
Generally, I understand course requirements better in an online course.	0.64	
Because of online courses, I am more likely to get a degree.	0.56	
I can manage my own learning better online.	0.54	
Take more online courses?	0.47	
I am motivated to succeed.		0.46
I have strong time management skills.		0.53
I am a multitasker.		0.57

Factor Analysis Source: Dziuban, C. et al. Student Satisfaction with Online Learning: Is it a Psychological Contract? *Online Learning, The Journal of the Online Consortium*. March, 2015.

Introduction to Research, Summer 2019: Pre-course survey

Skills: Presently I can…	Not confident	A little confident	Somewhat confident	Highly confident	Extremely confident
Design/conduct scientific investigations	0%	7%	33%	13%	0%
Analyze data from a scientific lab experiment	0%	0%	20%	27%	7%
Communicate the results of a scientific investigation	0%	0%	33%	20%	0%
Use research skills in order to advance my interest in science	0%	0%	20%	33%	0%
Attitudes: Presently, I am…	Not at all	Just a little	Somewhat	A lot	A great deal
Enthusiastic about STEM and research	0%	0%	7%	13%	33%
Interested in taking more STEM classes	0%	0%	0%	20%	27%
Thinking it is important to understand how advances in scientific research affect our daily life	0%	0%	0%	20%	33%
Seeing the value of doing research and laboratory work to understand science and real-world issues	0%	0%	7%	27%	20%

Source: Professor Sharadha Sambasivan, SCCC, Summer 2019; N=8

Introduction to Research, Summer 2019: Post-course survey

Skills: Presently I can	Not confident	A little confident	Somewhat confident	Highly confident	Extremely confident
Design and conduct scientific investigations	0%	0%	12%	38%	12%
Analyze data from a scientific lab experiment	0%	0%	0%	50%	12%
Communicate the results of a scientific investigation	0%	0%	25%	25%	12%
Use research skills in order to advance my interest in science	0%	0%	12%	35%	12%
Attitudes: Presently, I am	Not at all	Just a little	Somewhat	A lot	A great deal
Enthusiastic about STEM and research	0%	0%	12%	12%	38%
Interested in taking more STEM classes	0%	0%	12%	12%	38%
Thinking it is important to understand how advances in scientific research affect our daily life	0%	0%	12%	12%	38%
Seeing the value of doing research and laboratory work to understand science and real-world issues	0%	12%	12%	12%	25%

Source: Professor Sharadha Sambasivan, SCCC, summer 2019; N=5

Students feel engaged and motivated to succeed.

SUCCESS Retention and Graduation Rates

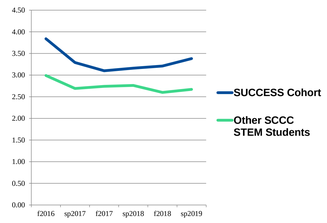
Retention	SUCCESS Cohort	Other STEM Students
F2016-Sp 2017	89%	70.7%
F2017-Sp2018	86.7%	68.5%

Average graduation rate for SUCCESS Cohort, Fall 2016-Spring 2019: 60%

Source: SCCC Office of Planning and Institutional Effectiveness, 2019.

SCCC SUCCESS Cohort GPA vs. SCCC STEM GPA, Fall 2016-Spring 2018

Cohort data vs. SCCC STEM student data (students who are not part of our programs)

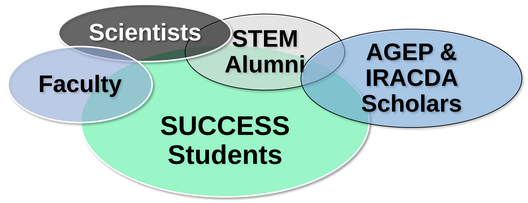


Source: SCCC Office of Planning and Institutional Effectiveness, 2019.

KNOWLEDGE GENERATION

- Students benefit from relationships with tutors and mentors.
- When compared to Suffolk's STEM students,
  - ✓ SUCCESS students earn higher GPA's
  - ✓ Exhibit higher retention, graduation and transfer rates.
- Students demonstrate a high level of engagement when participating in on-campus student-directed water quality research, as evidenced by Blackboard discussions and poster presentations.
- Students participating in off-campus summer research remained engaged through participating in an online Introduction to Science Research course.

THE STEM COMMUNITY AT SCCC



CONCLUSIONS

- SUCCESS is a robust program with indications of a very successful implementation.
- SUCCESS students perform better academically than their peers.
- The online Introduction to Science Research course engages students and contributes to student empowerment and persistence.
- Mentors and faculty provide continuous support.
- The SENCER Student Assessment of Learning Gains results indicate an increase in motivation, metacognition and progress toward course and programmatic goals.