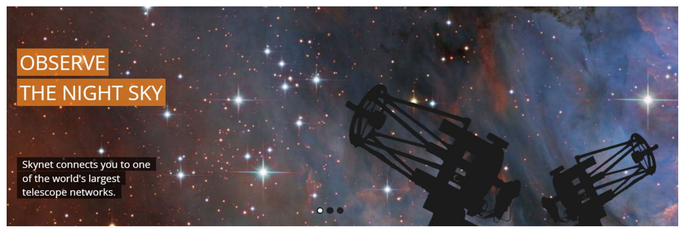
Our Place in Space! - Robotic Telescope Curriculum - Evaluation

Rachel Freed, University of North Carolina, Chapel Hill; Dan Reichart, University of North Carolina, Chapel Hill; David McKinnon, Edith Cowan University; Tiffany Stone-Wolbrecht, Associated Universities Inc.; Michael Fitzgerald, Las Cumbres Observatory; Saeed Salimpour, International Astronomical Union, Office of Astronomy for Education, Heidelberg, Germany

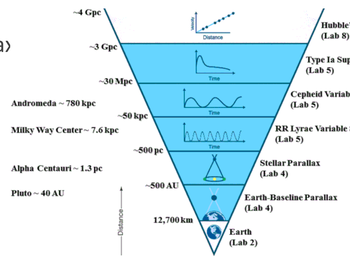
Skynet Global Telescope Network



Expanding Access to Robotic Telescopes for Undergraduates throughout the US and Canada

Skynet Labs

1. Introduction to Skynet
2. Earth and the Seasons
3. The Galilean Revolution
4. Cosmic Distance Ladder I - Parallax
5. Cosmic Distance Ladder II - Standard Candles
6. The Great Debate (Galaxy distances)
7. Rotation Curve and Mass of the Milky Way
8. Hubble's Law

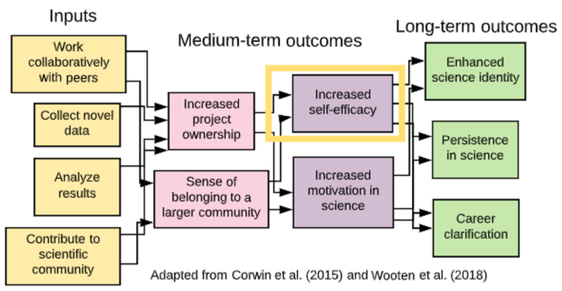


OPIS! curriculum and educational research goals

Fully develop partnerships across 37 colleges and universities.

Measure the impact of using robotic telescopes on students' efficacy, attitudes and career intentions.

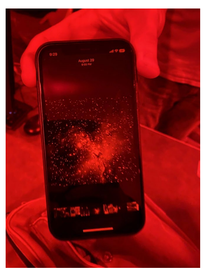
Develop a causal path model to explain the findings.



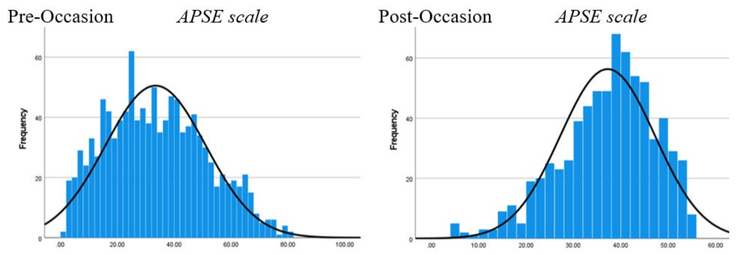
Adapted from Corwin et al. (2015) and Wooten et al. (2018)

Project Ownership

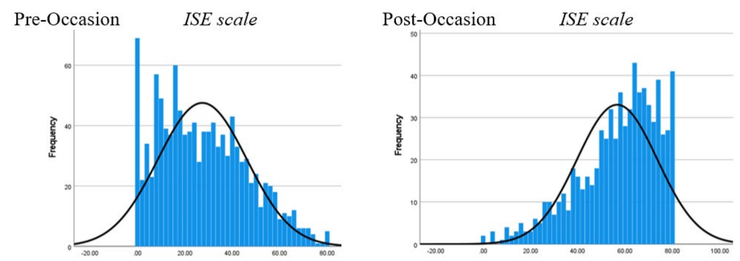
Students gain a sense of ownership over their images and data. Many students share their images with friends and family and on social media. Project ownership can be a precursor to building a STEM identity.



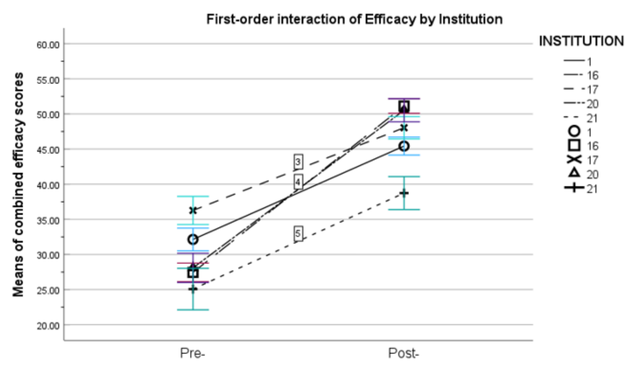
Self-Efficacy



Astronomy Personal Self-Efficacy (APSE) - learning astronomy content



Instrumental Self-Efficacy (ISE) - using telescopes and manipulating images



Institutions show varying degrees of improvement in self-efficacy over the course of a semester.

Effect Size - Cohen's D

Descriptive statistics of APSE and ISE by Institutions with Cohen's d effect size

Institution-Occasion	APSE pre- and post-				ISE pre- and post-		
	N	Mean	Standard Deviation	*Cohen's d*	Mean	Standard Deviation	*Cohen's d*
1-pre	79	34.557	17.460	0.180	29.203	19.420	1.340
1-post	79	37.182	10.958		53.722	17.113	
16-pre	*117*	*30.880*	*16.371*	*0.624*	*23.923*	*17.172*	*2.664*
16-post	*117*	*38.948*	*8.171*		*63.299*	*11.919*	
17-pre	51	36.588	17.180	0.130	35.039	21.671	1.112
17-post	51	38.399	9.640		57.333	18.277	
20-pre	*50*	*28.400*	*15.968*	*0.803*	*25.480*	*17.383*	*2.509*
20-post	*50*	*38.617*	*8.306*		*62.400*	*11.434*	
21-pre	24	24.500	13.355	0.413	24.417	13.393	1.382
21-post	24	29.620	11.387		47.458	19.413	
Total-pre	321	31.829	16.766	0.427	27.268	18.631	1.821
Total-post	321	37.677	9.676		58.670	15.746	

Lessons Learned

1. Curriculum works best when students can work together to help each other.
2. A mix of STEM and non-STEM majors helps the students succeed.
3. A professional learning community for the instructors is really beneficial.

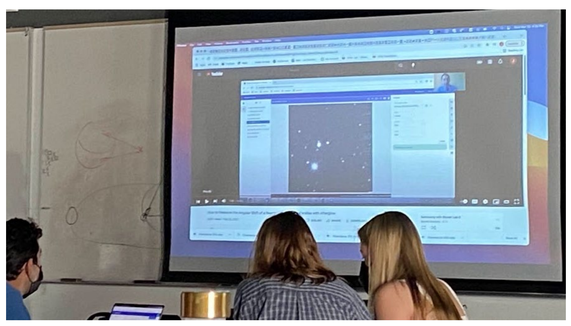
Closing the Gender Gap

Women had lower self-efficacy at the beginning of the semester and by the end of the semester there was no statistically significant difference between men and women's self-efficacy.

Observations and Student interviews

The OPIS! curriculum is being taught at over two dozen institutions and reaching several thousand students each semester. Educational researchers are observing the implementation of the OPIS! curriculum at each of the institutions to help understand the impacts of different approaches.

Students at a large university work in groups to collect data with Skynet robotic telescopes.



Students learn from video tutorials how to process their images and analyze the data that they collect.

This poster:
http://bit.ly/3oWWawZ

References

Freed, R., McKinnon, D., Fitzgerald, M., & Norris, C. M. (2022). Development and validation of an astronomy self-efficacy instrument for understanding and doing. Physical Review Physics Education Research, 18(1), 010117.

Freed, R., McKinnon D., Fitzgerald, M.T., & Salimpour, S. Confirmatory Factor Analysis of two self-efficacy scales for astronomy understanding and robotic telescope use. (submitted for publication)

Freed, R., McKinnon, D., Salimpour, S., Fitzgerald, M., Reichart, D., & Norris, C. M. Longitudinal and gender effects on self-efficacy in a large-scale robotic telescope-focused curriculum. (in preparation)