

Scaffolding supports student success in STEM



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Main Takeaways

- **Disaggregating data crucial to identifying gaps**
- **Integrated supports** boost student success, but even targeted interventions show efficacy
- **Major outcome:** Cross-institution collaboration has become an important driver of institution-level change

Institutional Data

- **Across disciplines:** Pell vs non-Pell 4-year graduation rates similar (75.3%)
- **Within STEM:** Disparities revealed (data predate project)
 - Across all students, only 70% of students continue beyond first year biology and chemistry courses
 - 49.4% STEM-intended students retained in STEM to junior year but 44.9% for low-income students and only 16.7% for students of color

Overall = 38% (n=635)	Female identified	Male identified
First generation students	32.9%	25.5%
Family income <\$35,000	30.4%	36.8%
Under-represented minorities	5.9%	35.7%

Table 1. Disaggregated data showing 4-year graduation rates for students intending STEM degrees upon matriculation (data represent 4 student cohorts).

University Mission

- As a Jesuit institution, JCU holds these values:
 - Caring for the whole person
 - Fostering a culture of reflection
 - Striving for rigorous, academic inquiry
 - Building a campus culture that promotes inclusion
 - Working towards a more just world

Research Questions

1. Does participation in a **STEM Living Learning Community** influence retention and persistence in STEM?
2. Do **guided reflection activities**, focused on vocational discernment, influence retention and persistence in STEM?

Program Goals

1. Closing retention gap via suite of scaffolded supports (Fig. 1)
2. Developing reflective, intentional decision-makers
3. Cultivating social justice-minded leaders
4. Preparing career-ready STEM professionals

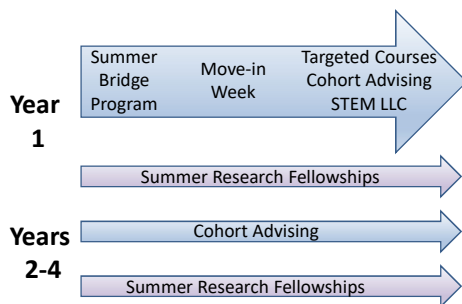


Fig. 1. Diagrammatic representation of scaffolded supports for scholars

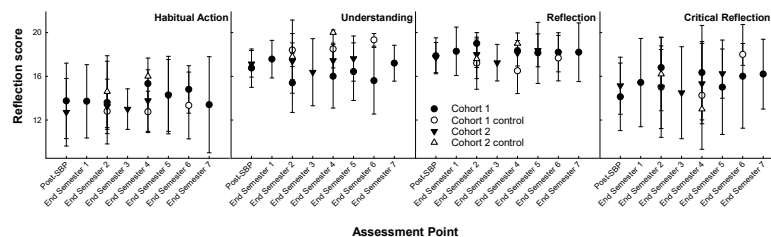


Fig. 3. Outcomes from Reflective Thinking Question Assessment (RTQA), a Likert Scale survey which assesses the extent to which scholars engage in reflective thinking following experiences. Four scale scores (Habitual Action, Understanding, Reflection, Critical Reflection) are calculated. Higher scale scores for any construct represents greater dependence on that construct (AY 2018-2020).

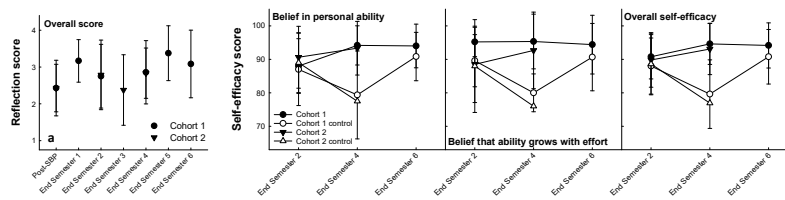


Fig. 5. Self-efficacy scores for Cohort 1 (black bars) vs its control group (white bars) after 2 years in college. Significant difference observed in belief in ability grows with effort ($P=0.0008$).



Fig. 4. (a) Outcomes from scholar written reflections, as scored by the REFLECT rubric (AY 2018-2020). **(b)** Word cloud represent themes from all scholar written reflections.

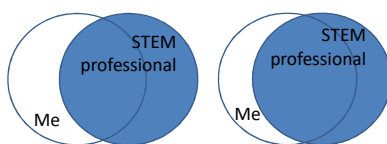


Fig. 6. The average scholar response across years of assessment averaged between these two diagrams, which represent >50% overlap between a scholars' identity and that of a scientist (based on McDonald et al. 2019).

Evidence of Effectiveness

1. Does participation in a **STEM Living Learning Community** influence retention and persistence in STEM?
 - More diverse than non-STEM floors (Table 1)
 - STEM LLC students spent **significantly more hours studying** per week than first year students on other residential floors ($t=4.083$, $P=0.00005$)
 - No initial observed difference in GPAs, but **STEM LLC students** graduated with **higher GPAs** than other students ($P=0.05$, 2021; $P=0.01$, 2022)—development of strong study habits early—long term positive impacts?
 - Four year retention rate was 79%, 4 year graduation was 77.2% (overall), with 62.3% of STEM LLC students graduating with a STEM degree
2. Do **guided reflection activities**, focused on vocational discernment, influence retention and persistence in STEM?
 - Significant initial turnover in Cohort 1 (2 transferred; 2 left program) but stable afterwards and no turnover in Cohort 2
 - Since stabilization, **strong academic performance** (average GPA>3.5)
 - **Increase in reflective thinking in scholars over time** (Fig. 3,4)
 - Higher understanding (lower on reflection scale) in controls vs scholars
 - Word clouds emphasize academics, relationships, and *magis* ("more").
 - **Higher self-efficacy in scholars versus control group** (Fig. 5)
 - Scholars are **working toward identifying as STEM professionals**, with respondents indicating >50% overlap between their self-perception and that of a STEM professional (**Fig. 6**)

Implementation at Other Institutions

- We recognize the complexity of our program—however, modularity make it possible to implement specific components at other institutions
- **STEM LLC:** most cost-effective intervention
 - Creates supportive, diverse community
 - Easily scalable
 - Strong academic and graduation outcomes—overall and STEM graduation rates from STEM LLC students higher than overall university rates
- **Summer Bridge Program:** most important for setting first year trajectory & brought many campus partners together but expensive and complicated
- **Cohort Advising:** highly effective at building community, developing metacognitive skills, combating "sophomore slump"
 - Creates consistent support network & builds bridges across faculty & staff
 - Time intensive (particularly in year 1)
 - Consistent mentoring likely supported sustained self-efficacy, particularly during sophomore year, and development of STEM professional identity

References	Acknowledgments
Gaumer & Noonan 2018 The skills that matter: Teaching interpersonal & intrapersonal competencies in any classroom Kember et al. 2000 Assessment & Eval in Higher Ed 25: 381-395 McDonald et al. 2019. Frontiers in Education 4(78) online only Wald et al. 2011 Academic Medicine 87: 41-50	We thank the JCU MIRRORS team & scholars and the Rucks Group for their support. A grant from the National Science Foundation supported this work (NSF DUE 1741814).