Teacher Research Experiences in Astronomy as Professional Learning.

Threats to Validity and opportunity studying a heterogeneous, low population, research sample.

Michael Fitzgerald

Precursors of the project.

- NITARP
- ATARP

- Caltech – 8 to 20 teacher participants per year.
- $30,000 cost per teacher.

NITARP

- 1 day NITARP bootcamp at Janurary AAS
- At least 2 days of immersion into the AAS conference
- Write up a proposal at home with team
- 4 intensive days at Caltech with JPL tour in summer
- Work remotely, collaborate on project, create posters
- Return, with students, to AAS to present their results.

PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH **14,** 020102 (2018)

Major outcomes of an authentic astronomy research experience professional development program: An analysis of 8 years of data from a teacher research program

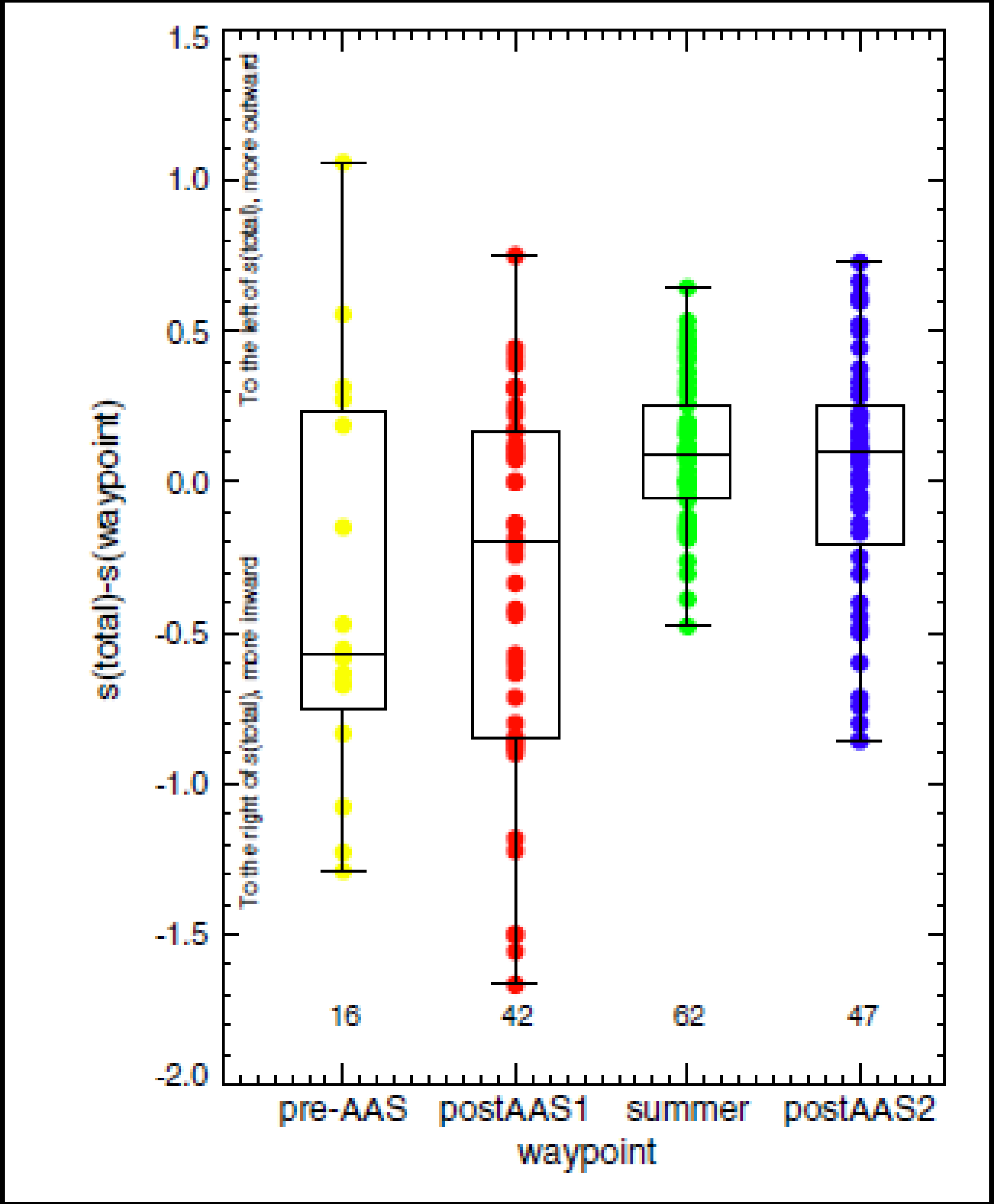
PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH **14,** 010148 (2018)

Motivations of educators for participating in an authentic astronomy research experience professional development program

Robotic Telescopes, Student Research and Education (RTSRE) Proceedings
Conference Proceedings, San Diego, California, USA, Jun 18-21, 2017
Fitzgerald, M., James, C.R., Buxner, S., White, S., Eds. Vol. 1, No. 1, (2018)
ISBN 978-0-6483996-0-5 / doi : 10.32374/rtsre.2017.016 / CC BY-NC-ND license
Peer Reviewed Article. rtsre.net/ojs

The NASA/IPAC Teacher Archive Research Program (NITARP)

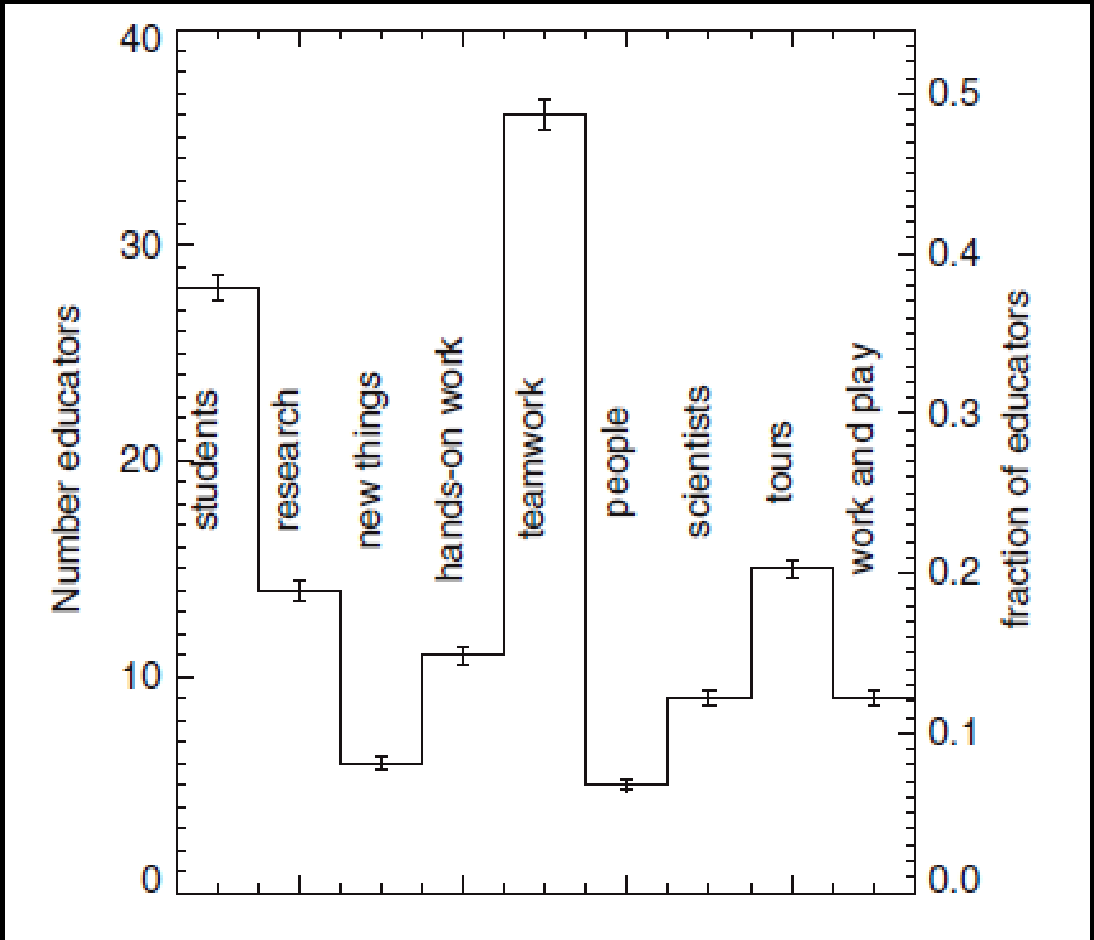
L. M. Rebull[1*], M. Fitzgerald[2], T. Roberts[3], D. A. French[4], W. Laurence[5], V. Gorjian[6], G. K. Squires[3]



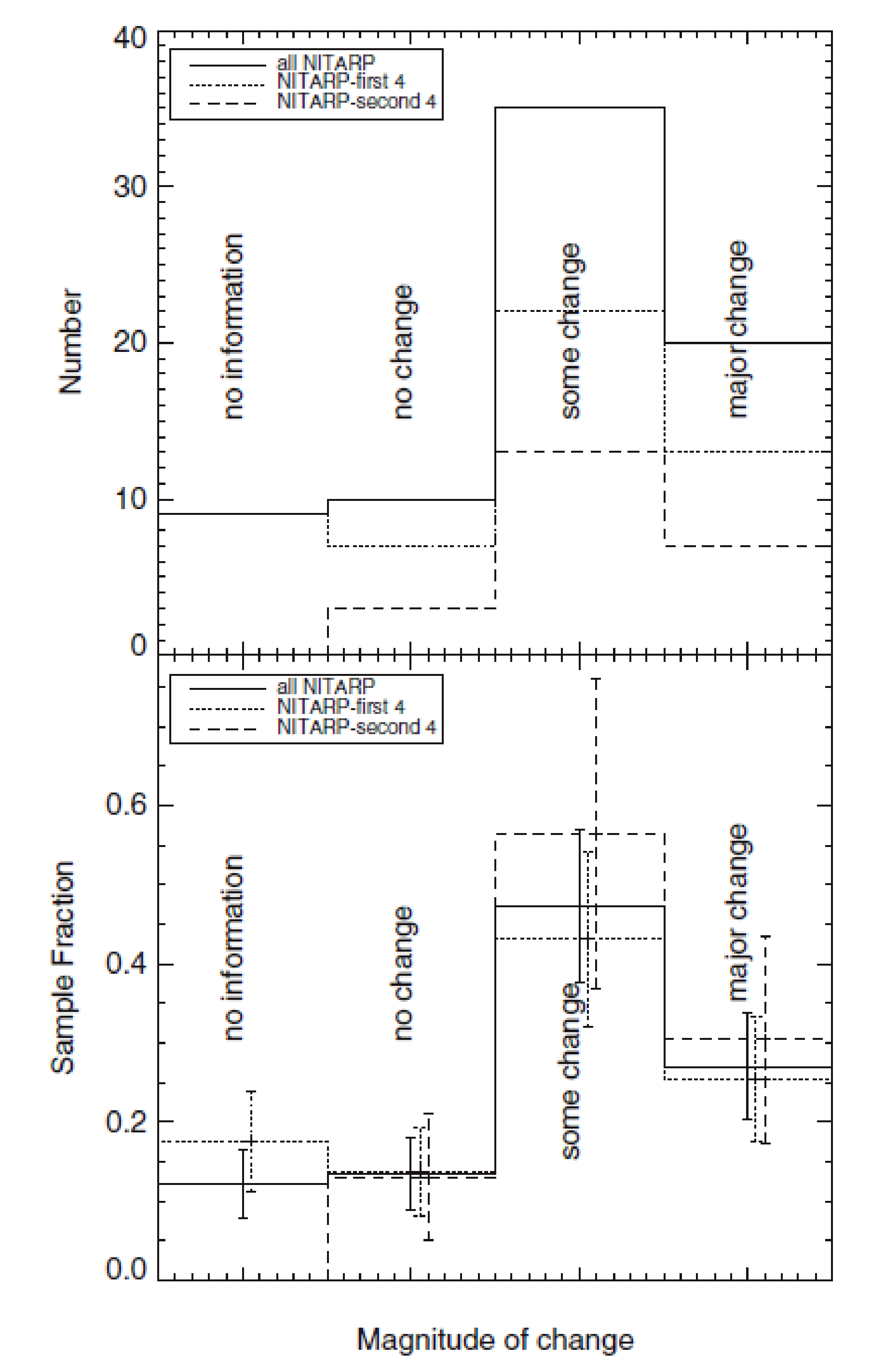
Being with the people drawn together at this type of meeting helps me as a teacher to see what is needed from me in prepare and present to my students as the current world of science. I also get to see and experience things that make my own brain start clicking and re-engage that wonder and questioning part of me that made me love science and want to go into science as a kid. I came away with many new ideas, new contacts to offer me support in my teaching and research, and a renewed enthusiasm for improving my teaching and my own understanding of astronomy.—NITARP educator, 2013 class

The best thing about the trip was the chance to interact with others who are trying to do the same things that I am trying to do. No one else around me tries to do student research (even though I have tried to get other teachers involved), not in my district nor in any of the surrounding ones. It was great to spend time with other teachers (and their students) who are trying to accomplish the same things that I am trying to do.—NITARP educator, 2013 class

The BEST subject-area professional development experience I've had in 25 years BY FAR, and one of the most intellectually stimulating experiences I've had in years. I lie awake at night thinking about data.—NITARP educator, 2014 class



Number educators
fraction of educators
students
research
new things
hands-on work
teamwork
people
scientists
tours
work and play
0
10
20
30
40
0.0
0.1
0.2
0.3
0.4
0.5



all NITARP
NITARP-first 4
NITARP-second 4
Number
no information
no change
some change
major change
0
10
20
30
40
Sample Fraction
0.0
0.2
0.4
0.6
Magnitude of change

- Led by astronomers -> Observe first, ask questions later!
- Not ed. Researchers -> theory, ethics, rigour, threats, etc.
- Valuable, multiple measures but not embedded in a research field.

ATARP: Australian Teacher Astronomy Research Program

The ATARP program will provide Australian High School science teachers with an authentic research experience in Australia's strongest STEM area, radio astronomy. Teachers will interact with radio telescope facilities in Australia. They will undertake authentic astronomical research over the course of 13 months in a team mentored by a professional astronomer from CSIRO Perth.

This early pilot project will have two mentor astronomers (one female, one male) each guiding two teachers: a total of four teachers (two females and two males). Teachers will also be encouraged to involve a small group of their students with this research project.

Participants will be embedded in an authentic experiential science learning model that teaches them deep content in a collaborative research environment. This provides the direct experience of undertaking current astronomical research and the nature of science that can be translated into their classroom environment and into their professional teaching network. Teachers will gain confidence in their understanding of science and of how scientists work. They will present their findings at the Annual meeting of the Astronomical Society of Australia in July each year.

Funding agencies

ECU Strategic Initiative Fund
Athena-Swann Initiative
Edith Cowan Institute for Education Research

Project duration

January 2017 - Ongoing

ATARP

- Does NITARP work in Australia?
- Pilot program 2017-2018
- Two trips to the ASA – problematic: School Holidays and CONASTA
- Conflicts with school schedule (June/July summer in the USA, middle of the school year… chaos!)

What is ATARP?

- Australian Teacher Astronomy Research program
- Providing high school science teachers with authentic research experience in Australia's strongest STEM area, radio astronomy

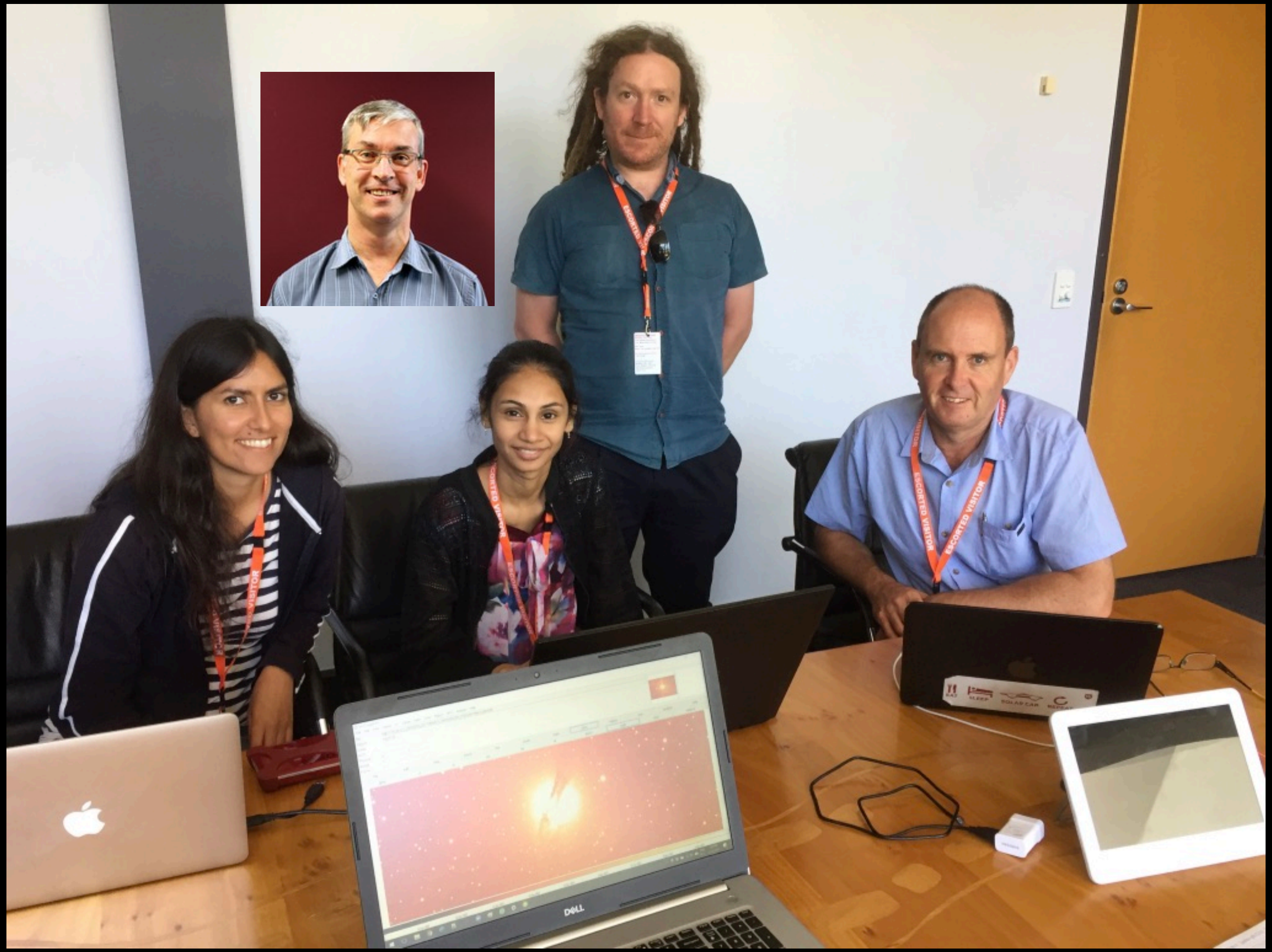


Photo credit: Rob Hollow, CSIRO

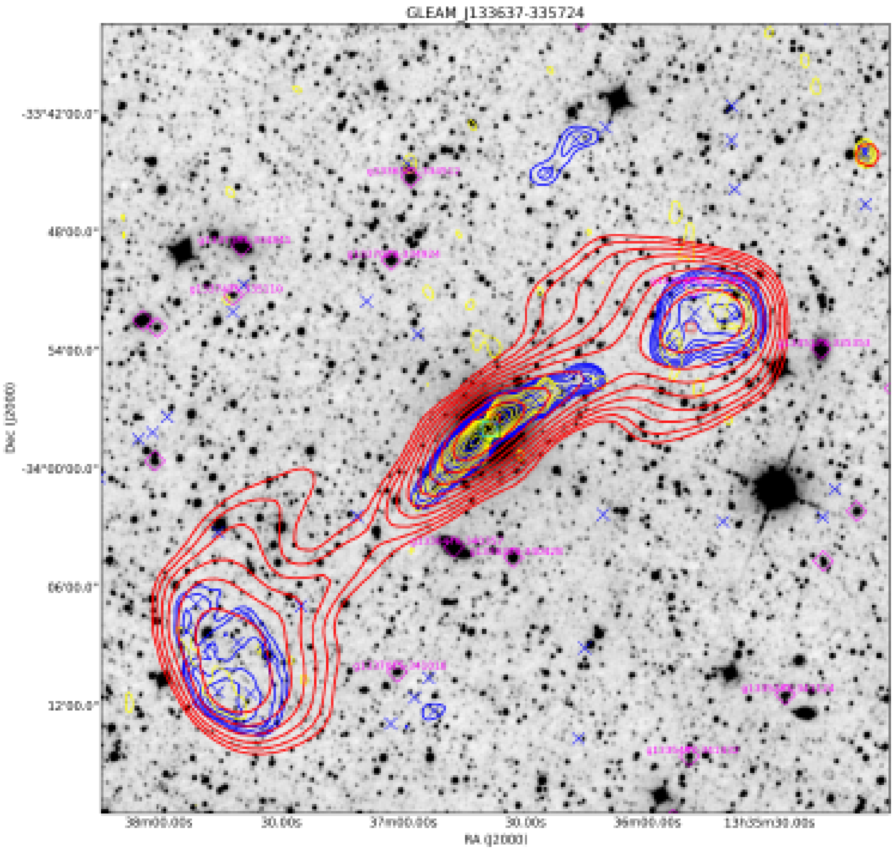
ATARP

- 4 days at ASA Conference
- Proposal broadly set by scientist prior to experience
- 1 day workshop at ICRAR Perth tour in summer
- Work remotely, collaborate on project, create posters
- Return to the ASA to present their results.

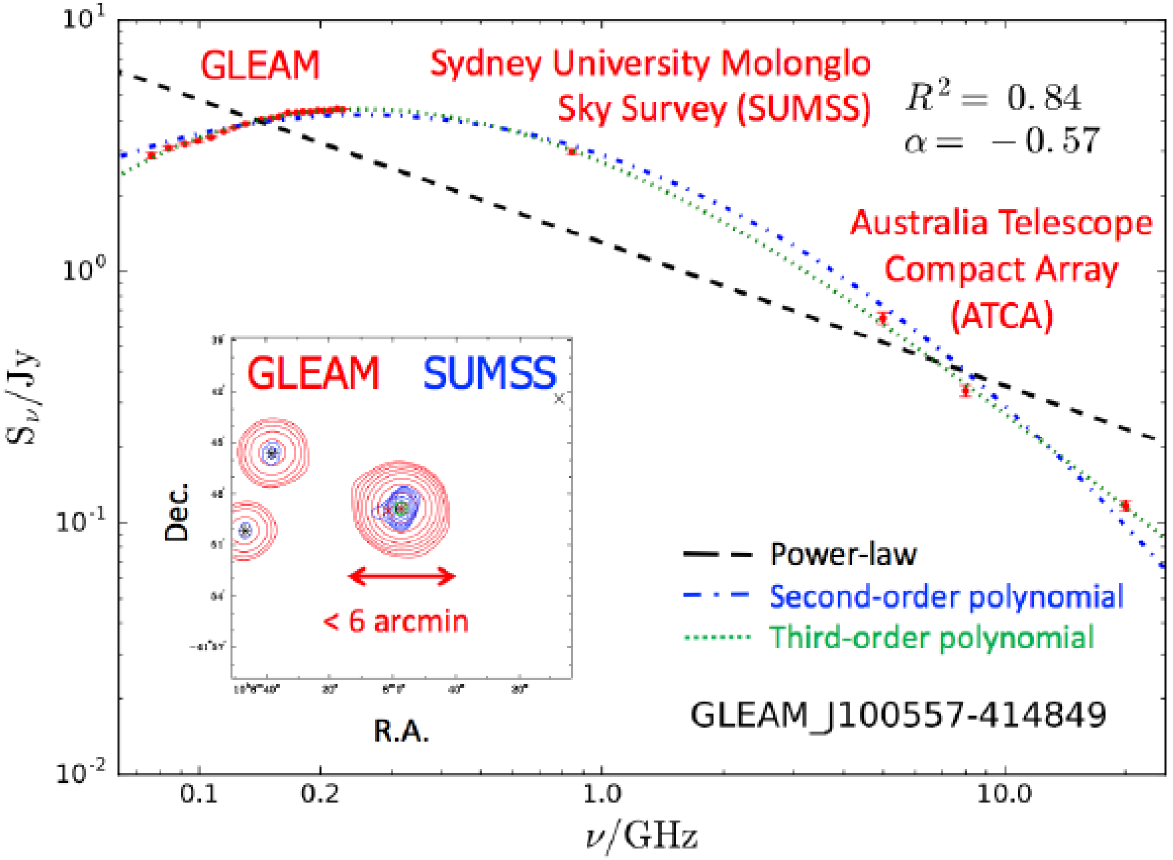
Studying the brightest sources detected with the Murchison Widefield Array (MWA)

Supervisor: Dr Sarah White (ICRAR/Curtin University)

The Murchison Widefield Array (MWA) has observed the entire southern sky at low radio-frequencies (< 300 MHz) for the first time. This constitutes the GaLactic and Extragalactic All-sky MWA (GLEAM) Survey, and in this project we will be investigating the brightest (~2000) sources, known as the GLEAM 4-Jy Sample. This sample is mostly made up of very powerful radio-galaxies, many of which have a supermassive black-hole that is accreting material and launching huge radio-jets. We will combine MWA data with those at higher radio-frequencies, in order to study the radio spectra of these galaxies (i.e. how their brightness varies as a function of frequency).



The spectral shape allows us to identify a variety of radio sources. This includes blazars, where we are looking down the axis of the radio jet, and sources with a large reservoir of neutral gas, which fuels both accretion and star formation. In addition, broadband radio spectra help to pinpoint rare objects, such as restarted radio-galaxies. These are radio galaxies where a second set of radio jets appear to have 'switched on', giving us a better idea of the timescales involved in jet production. Our study will provide new insights into the roles that these sources play in galaxy evolution, and pave the way for future radio surveys to be conducted in preparation for the Square Kilometre Array (SKA).



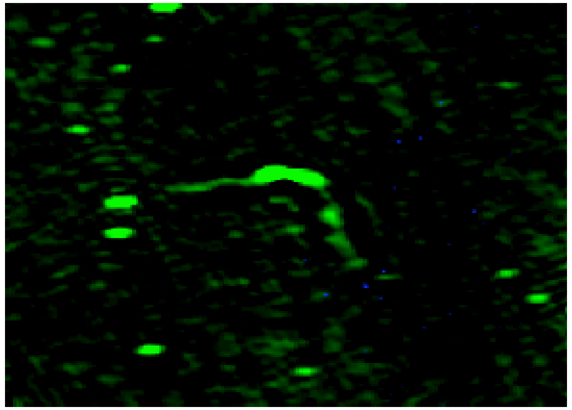
Galaxy Zoo with new ASKAP data
with Juan Madrid (CSIRO)

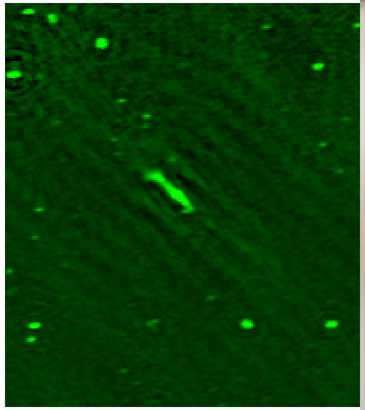
The Australian Square Kilometre Array Pathfinder (ASKAP) recently obtained data for four Early Science fields: M83, NGC 7232, Doradus, and the Fornax Cluster. This project would aim at making the first catalogue of double sources, or Active Galactic Nuclei, imaged with ASKAP.

ASKAP has much better resolution than other radio telescopes and this will allow us to identify sources with radio jets, or AGNs. The field of view of each Early Science Field is also very large (~6x6 arcminutes), we thus expect to detect hundreds of radio jets.

These jets are plasma beacons that emanate from supermassive black holes in the cores of massive galaxies. These jets are often double sided, as shown on the images below, we can thus classify them based on their morphology. The basic question that this project would aim at answering is: how many of these sources do we have on our Early Science Fields? The catalogue of radio jets build through this project can be used as a training dataset for a team at CSIRO running an artificial intelligence experiment.

We will also use data obtained with other astronomical facilities at different wavelengths (near-infrared, optical). If time permits, we can also look at time variability of the different radio sources. That is, how is their flux changing with time? Indeed, data for the same field were obtained during a period of several weeks.





But WHY?

- “inquiry based learning” is a key part of the NGSS as well as the Australian curriculum.

- “You cannot teach what you have not done.”

But WHY?

- Calls for more STEM in schools.

Benefit

The report *Science, Technology, Engineering and Mathematics: Australia's Future* prepared by the Office of the Chief Scientist (OCS) (2014) contains a variety of objectives related to STEM education that our nation must tackle. The report states that a secure pipeline, inspirational teaching, and inspired learning are required to lead to a skilled workforce and an engaged community. These are not only necessary for our performance as a nation, but as citizens in the new knowledge society (Gilbert, 2005) where the focus is on the creation of new knowledge and new understandings.

To address these issues, the Australian Curriculum mandates inquiry-based learning, as do the Next Generation Science Standards (NGSS; USA) which require students to understand the methods of scientists and engineers, as well as specific science content and concepts. The Australian Curriculum states that students should understand how scientific knowledge is generated and accepted as well as its social and historical dimensions. However, many teachers are wholly unequipped to teach in this manner and typically have great difficulty in implementing inquiry-based learning in the classroom (Fitzgerald et al., 2017).

A key concern for all science education stakeholders is the gap between the high levels of scientific literacy (in the nature of science, science inquiry and scientific content knowledge) needed by citizens for 21st century careers, and the reality of the low levels of scientific literacy and interest in science and science careers measured in our schools, universities and general citizenry. The four most important skills and attributes Australian employers look for in STEM graduates (Prinsley & Baranyai, 2015) - active learning, critical thinking, complex problem-solving and creative problem solving - are all strongly related to issues about the nature of science or science inquiry rather than straight science content knowledge. Indeed, it is notable that Prinsley & Baranyai (2015) make no mention of actual scientific content knowledge as being important, while the ability to learn on the job (active learning) is valued the most highly by employers.

NSW Syllabus

NSW EDUCATION STANDARDS AUTHORITY

Science Extension

Stage 6
Syllabus

DEPTH STUDIES: YEAR 11 AND 12

What are Depth Studies?

A depth study is any type of investigation/activity that a student completes individually or collaboratively that allows the further development of one or more concepts found within or inspired by the syllabus. It may be one investigation/activity or a series of investigations/activities.

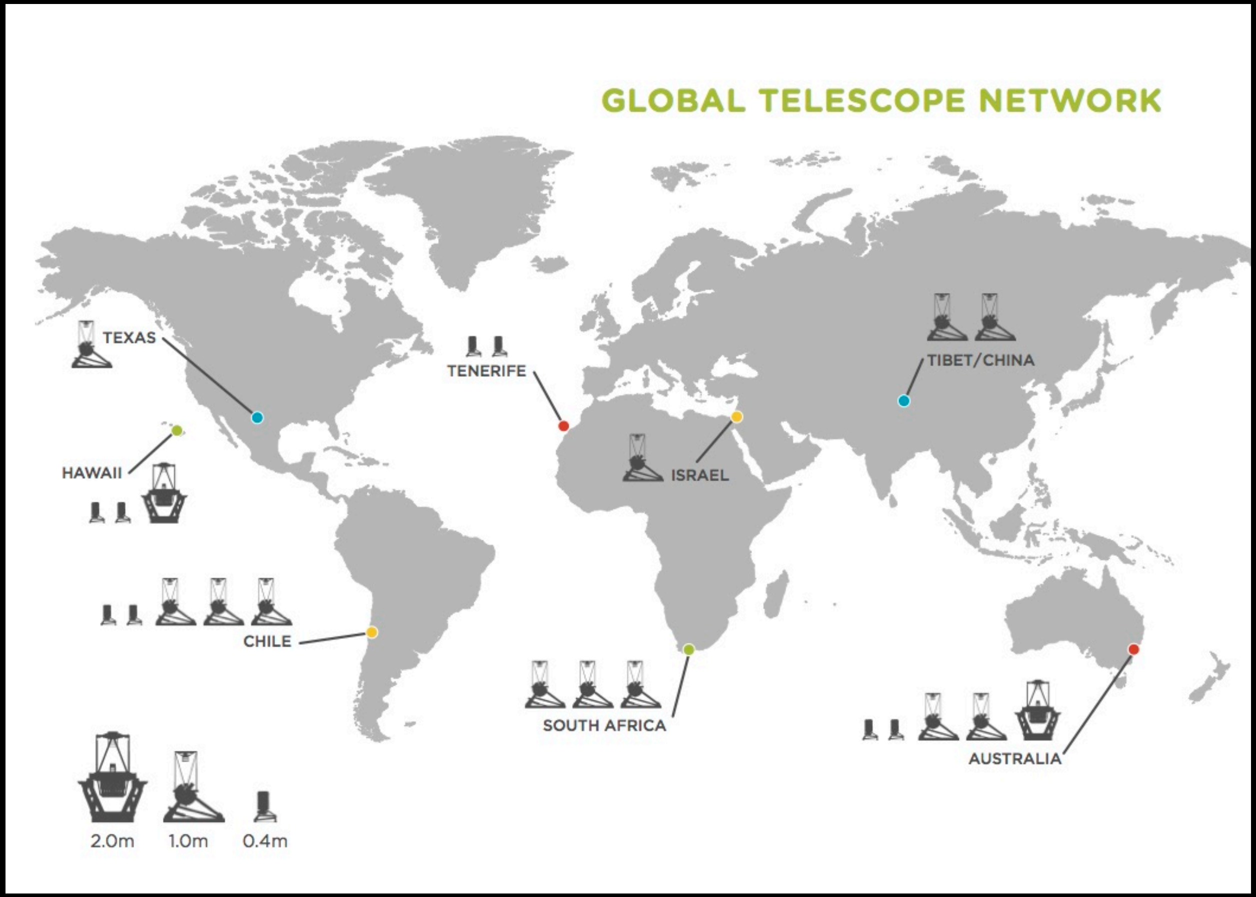
Depth studies provide opportunities for students to pursue their interests in science, acquire a depth of understanding, and take responsibility for their own learning. Depth studies promote differentiation and engagement, and support all forms of assessment, including assessment for, as and of learning. Depth studies allow for the demonstration of a range of Working Scientifically skills.

A depth study may be, but is not limited to:

- a practical investigation or series of practical investigations and/or a secondary-sourced investigation or series of secondary-sourced investigations

But WHY Astronomy?

- Ease of access, open source.



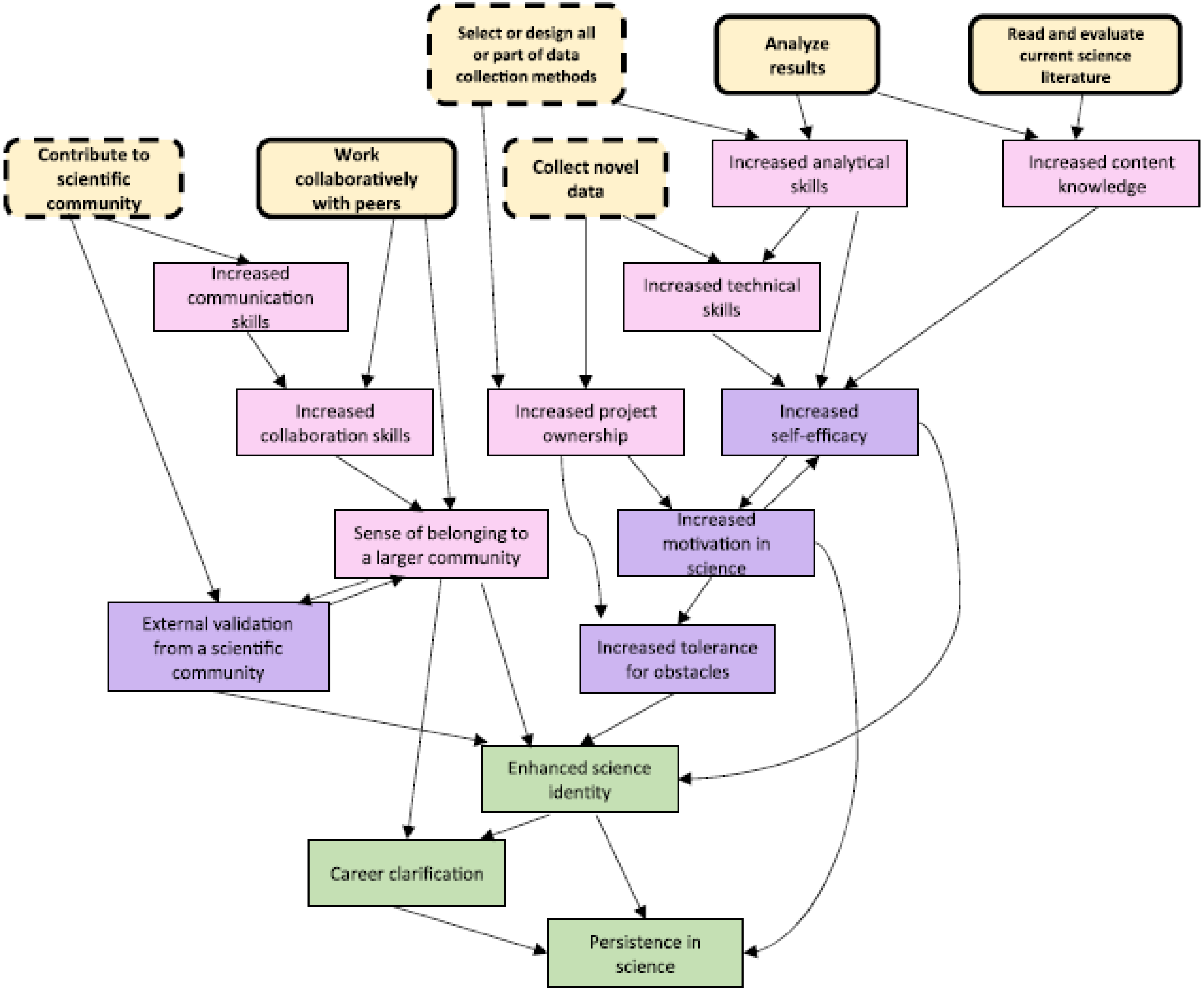
Previous Research

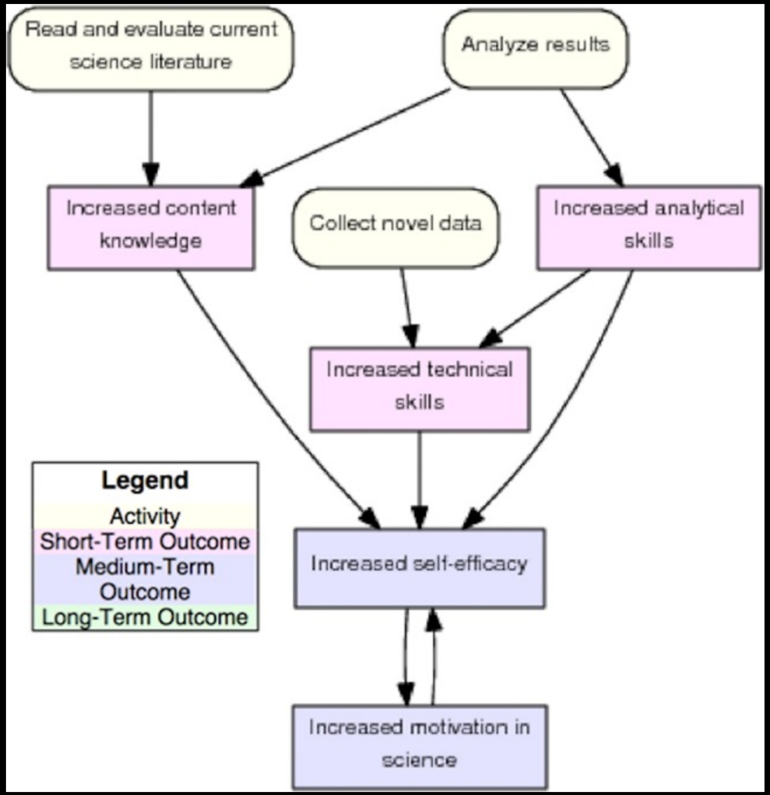
- Buxner's (2014) predominantly qualitative study of teachers' understanding about scientific inquiry and the nature of science after three different summer teacher research experience programs. She found that the outcomes intended by project personnel, such as strong changes in teachers' understandings of science inquiry and how to implement research with their students, did not commonly occur. Teacher self-report descriptions of their science teaching, personal and professional growth, confidence and classroom activity did, however, change significantly after participation.
- Sadler, Burgin, McKinney, and Ponjuan (2010) summarised a number of trends from 11 non-astronomy focussed teacher research experience programs. Only mixed results of classroom transformation were seen with minimal increases in teacher understanding. Most data in the field they reviewed were over-reliant on interviews and self-report surveys with questionable reliability and validity. For those relatively rare studies of the 11 that used more robust pre/post research designs, it is notable that the positive responses to self-report open questions were not correlated with changes in quantitative measurements of the teachers' self-efficacy, understanding of the nature of science or science content knowledge. This indicates that, at the very least, post-test-only open response studies are a poor proxy indicator of impact on either teachers or students.

Theoretical Framework

- Corwin et al. 2015

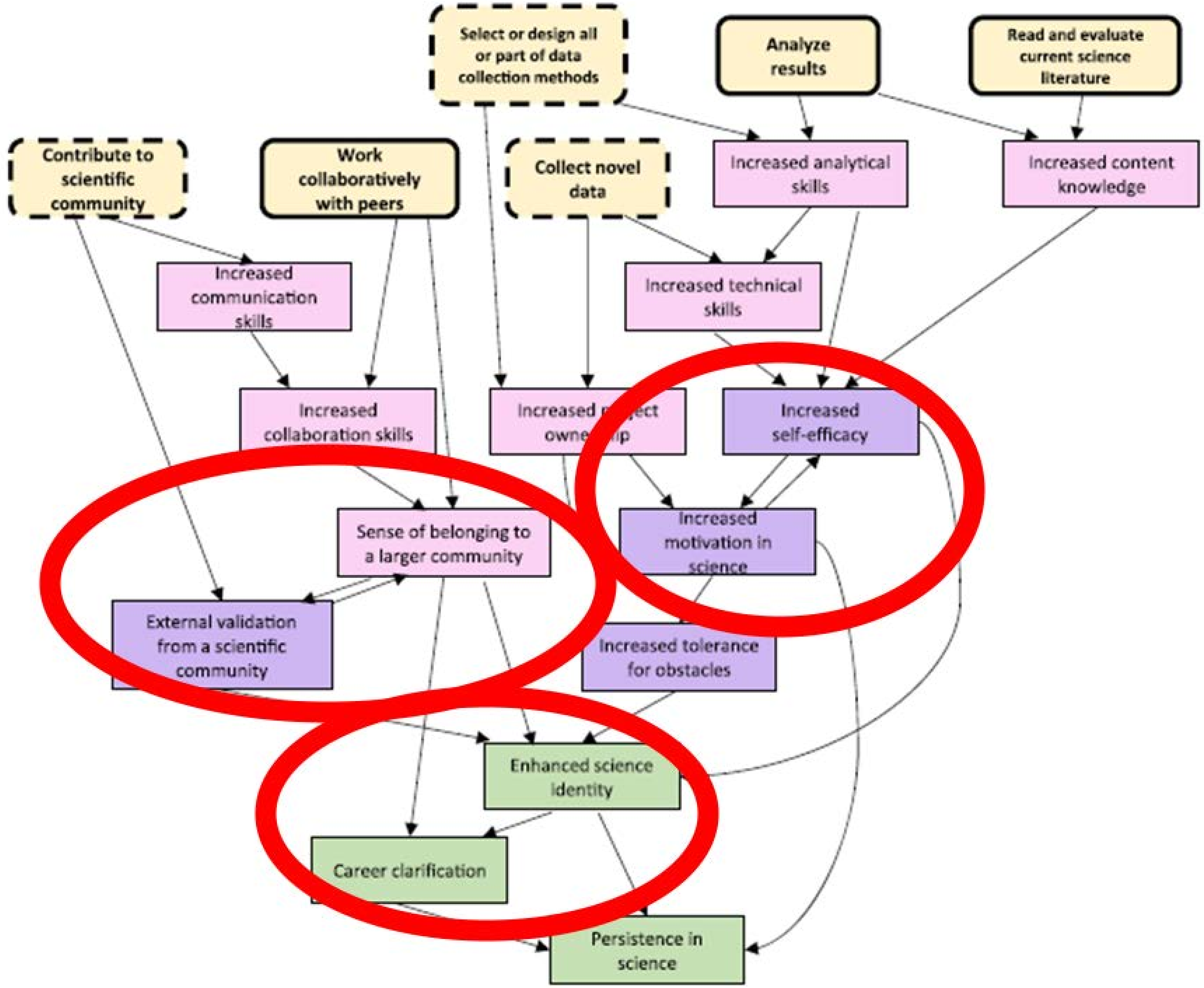
- CURE in
life sciences



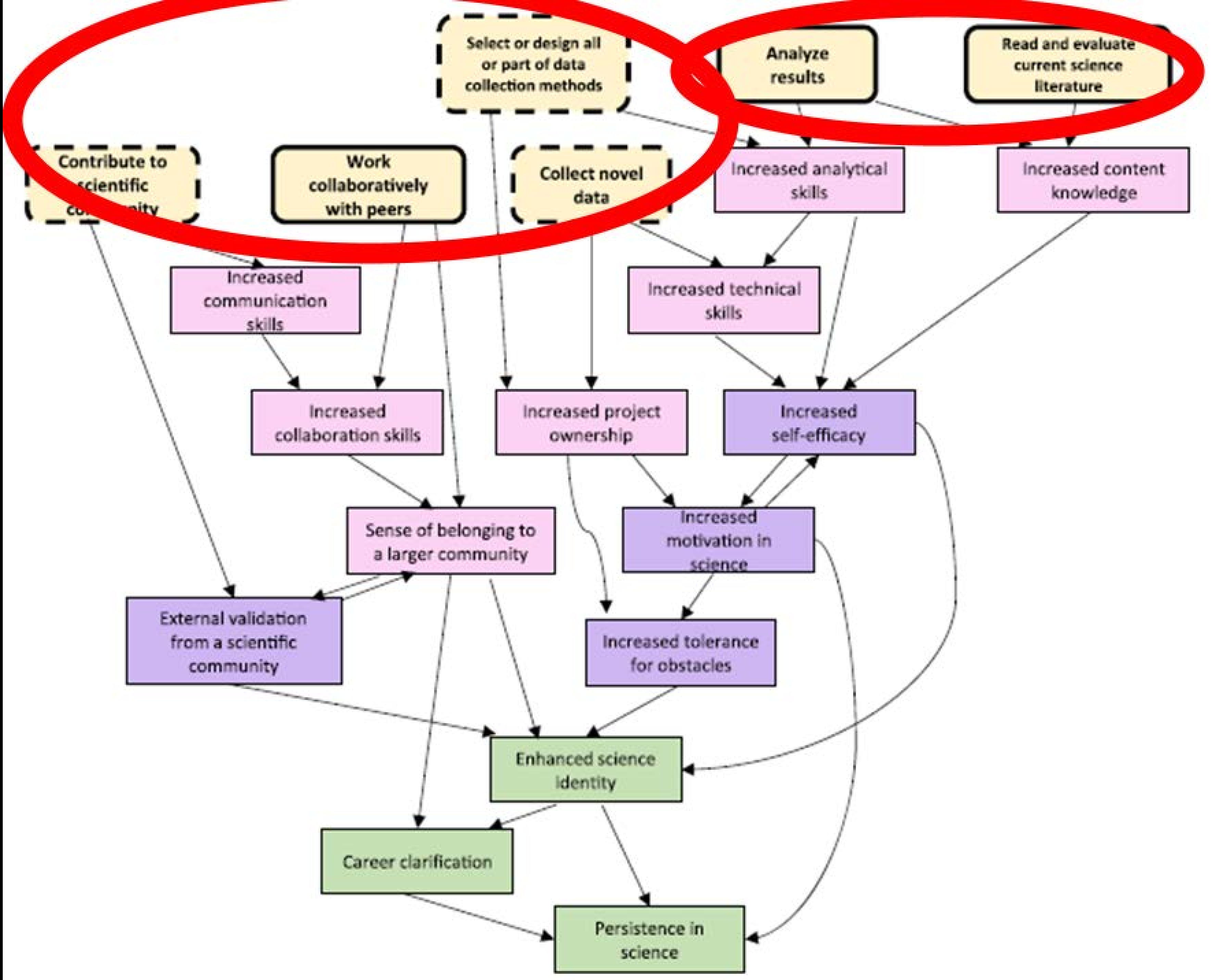


	Outcome	CURE References
Probable	Increased content knowledge	Lopatto et al. 2008; Shaffer *et al.*, 2010, 2014; Siritunga *et al.*, 2011; Brownell *et al.*, 2012; Rowland *et al.*, 2012; Jordan *et al.*, 2014; Kloser *et al.*, 2013
	Increased analytical skills	Shaffer *et al.*, 2010, 2014; Siritunga *et al.*, 2011; Bascom-Slack *et al.*, 2012; Brownell *et al.*, 2012; Hanauer *et al.*, 2012; Alkaher and Dolan, 2014; Jordan *et al.*, 2014
	Increased self-efficacy	Drew and Triplett, 2008; Lopatto *et al.*, 2008; Shaffer *et al.*, 2010, 2014; Siritunga *et al.*, 2011; Kloser *et al.*, 2013; Jordan *et al.*, 2014
	External validation from a science community	Hatfull *et al.*, 2006; Lopatto *et al.*, 2008; Caruso *et al.*, 2009; Shaffer *et al.*, 2010, 2014; Jordan *et al.*, 2014
	Persistence in science	Drew and Triplett, 2008; Harrison *et al.*, 2011; Hanauer *et al.*, 2012; Bascom-Slack *et al.*, 2012; Brownell *et al.*, 2012; Jordan *et al.*, 2014; Shaffer *et al.*, 2014
	Increased technical skills	Drew and Triplett, 2008; Shaffer *et al.*, 2010; Jordan *et al.*, 2014; Rowland *et al.*, 2012
	Career clarification	Drew and Triplett, 2008; Harrison *et al.*, 2011; Shaffer *et al.*, 2014
Possible	Increased project ownership	Shaffer *et al.*, 2010; Hanauer *et al.*, 2012; Alkaher and Dolan, 2014
	Increased communication skills	Lopatto *et al.*, 2008; Jordan *et al.*, 2014; Shaffer *et al.*, 2014
	Increased motivation in science	Shaffer *et al.*, 2010, 2014; Alkaher and Dolan, 2014
	Increased collaboration skills	Shaffer *et al.*, 2010, 2014
	Increased tolerance for obstacles	Jordan *et al.*, 2014; Shaffer *et al.*, 2014
	Increased sense of belonging to a larger community	Jordan *et al.*, 2014; Shaffer *et al.*, 2014
	Enhanced science identity	Hanauer *et al.*, 2012; Alkaher and Dolan, 2014
	Increased positive interaction with peers	Shaffer *et al.*, 2010; Alkaher and Dolan, 2014
Proposed	Increased access to faculty interaction	Alkaher and Dolan, 2014
	Increased access to mentoring functions	Hanauer *et al.*, 2012
	Enhanced understanding of the nature of science	Russell and Weaver, 2011
	Development of self-authorship	Alkaher and Dolan, 2014

- You can only measure so much….

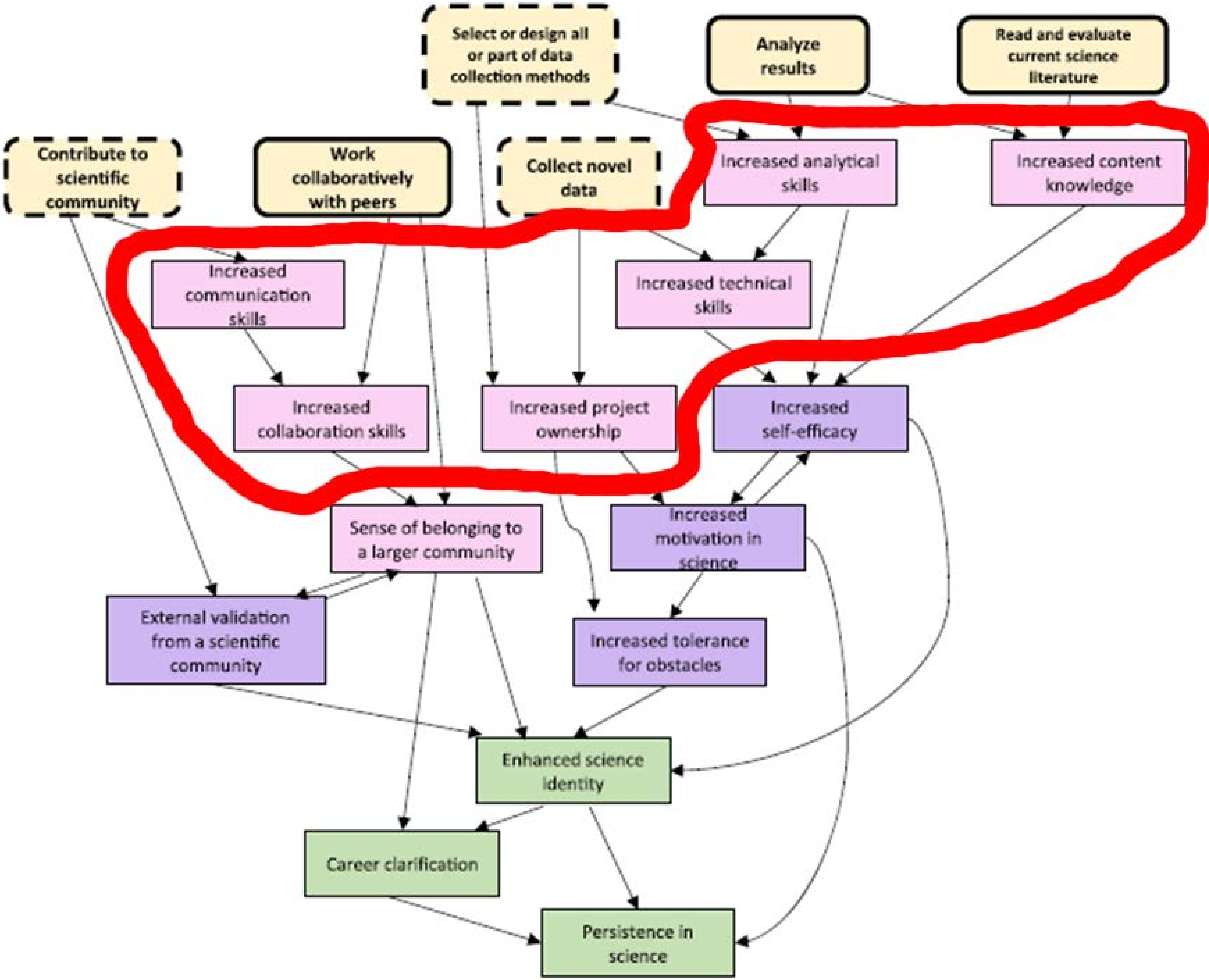


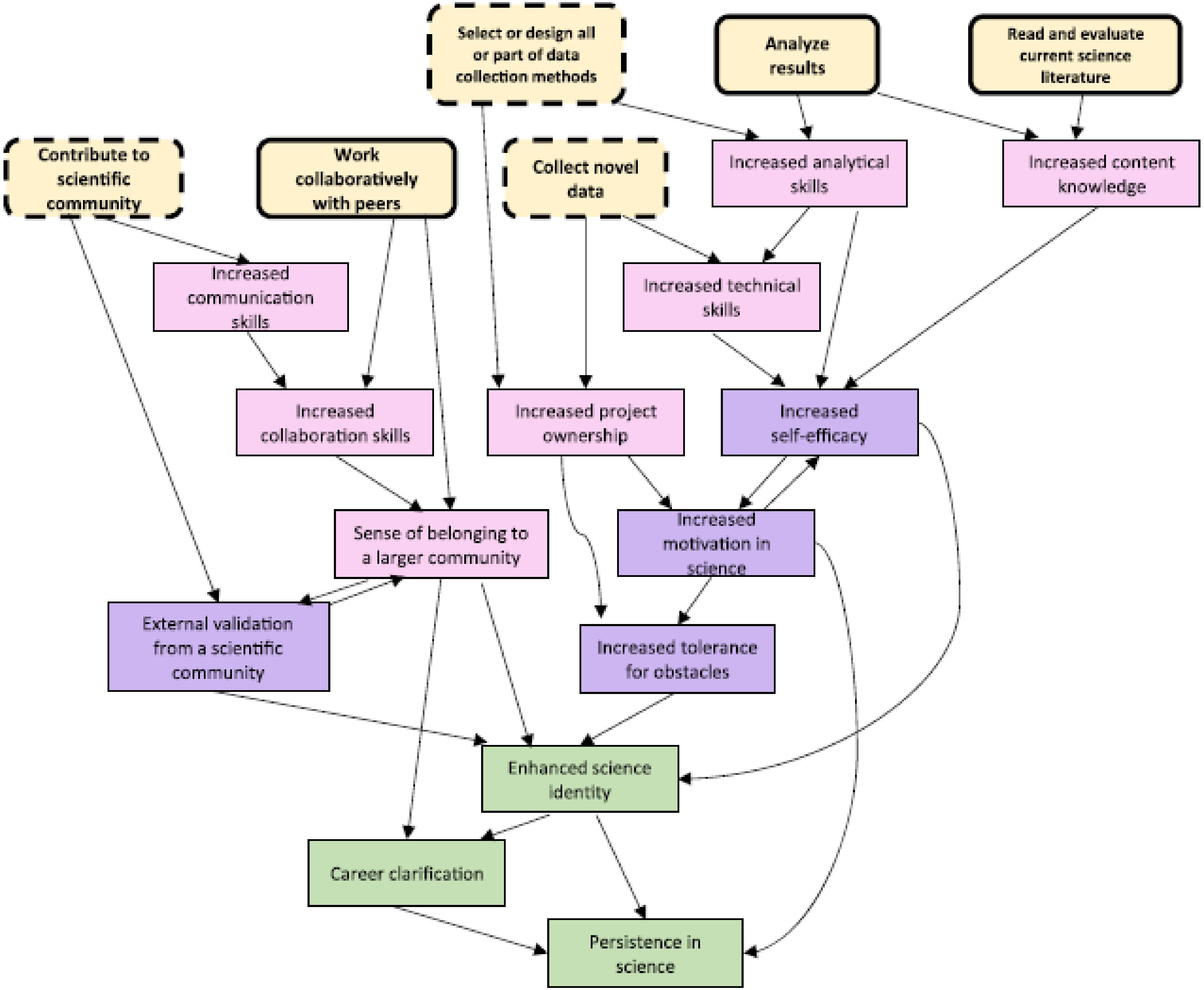
- This is what changes between projects



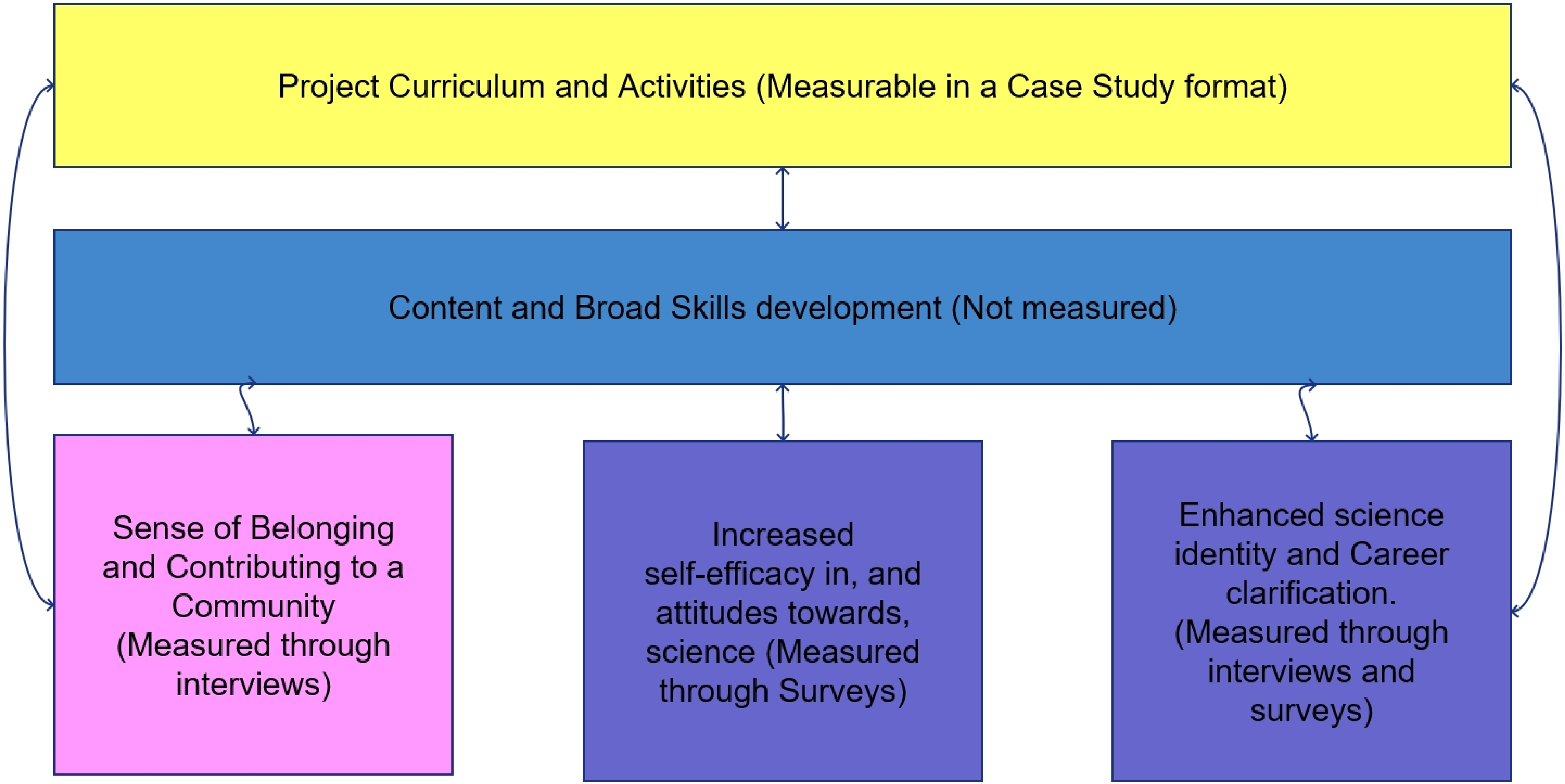
- We aren't looking here….. we just (safely) assume they are happening

Content knowledge = fish in a barrel





Select or design all or part of data collection methods
Analyze results
Read and evaluate current science literature
Contribute to scientific community
Work collaboratively with peers
Collect novel data
Increased analytical skills
Increased content knowledge
Increased communication skills
Increased technical skills
Increased collaboration skills
Increased project ownership
Increased self-efficacy
Sense of belonging to a larger community
Increased motivation in science
External validation from a scientific community
Increased tolerance for obstacles
Enhanced science identity
Career clarification
Persistence in science


Project Curriculum and Activities (Measurable in a Case Study format)
Content and Broad Skills development (Not measured)
Sense of Belonging and Contributing to a Community (Measured through interviews)
Increased self-efficacy in, and attitudes towards, science (Measured through Surveys)
Enhanced science identity and Career clarification. (Measured through interviews and surveys)

How to measure the various bits?

Well… initially there were not instruments to measure them!

- Attitudes towards Astronomy
- Self-Efficacy
- Interviews – science identity, community and qual. triangulation
- Case Study / Triangulation / Rich Data / Descriptive
- Career intentions – survey and Interview (part of science identity)

Multiple measures are used to boost our statistical power.

Astronomy And Science Student Attitudes (ASSA): A Short Review And Validation Of A New Instrument

Sophie Bartlett, Cardiff University, United Kingdom
Michael T. Fitzgerald, Edith Cowan University, Australia
David H. McKinnon, Edith Cowan University, Australia
Lena Danaia, Charles Sturt University, Australia
Jasmina Lazendic-Galloway, Monash University, Australia

Factor
Interest in Astronomy
Science Outside of School
Practical Work in Science
Teacher's Actions
Ability in Science
Future Aspirations in Science
Benefits of Science
Personal Relevance to Science

Table 1. Pattern Matrix for the 6 Factor Solution

	Factor Loadings (Pattern Matrix)					
	1	2	3	4	5	6
I would like to do astronomy as a hobby.	.774					
I find astronomy interesting.	.734					
I feel drawn to the night sky.	.685					
I would like to undertake astronomy as a career.	.680					
I would like to own my own telescope.	.677					
I have a strong interest in learning about the universe.	.604					
I am interested in the stories behind the constellations.	.562					
I like watching science programmes on TV.	.556					
I like to visit science museums.	.548					
I would like to do more science activities outside school.	.545					
I like reading science magazines and books.	.535					
It is exciting to learn about new things happening in science.	.499					
I would like to join a science club.	.450			.352		
I like to use scientific tools to study the world around me.	.436					
I would prefer to use a large research telescope through the internet than a smaller telescope in my backyard.						
I would like more practical work in my science lessons.		.893				
I look forward to doing science practicals.		.830				
I would rather do a science experiment than read about science.		.810				
We learn science better when we do practical work.		.799				
Practical work in science is exciting.		.793				
I like science practical work because you don't know what will happen.		.777				
Practical work in science is boring. (Recoded.)		.679				
Practical work in science is good because I can work with my friends.		.667				
I like practical work in science because I can decided what to do myself.		.628				
My science teacher shows us how new work relates to what we have already done.			-.830			
My science teacher takes notice of students' ideas.			-.828			
My science teacher makes it clear what we have to do to get good marks.			-.814			
My science teacher tells me how to improve my work.			-.807			
My science teacher talks to me about how I am getting on in science.			-.782			
My science teacher uses language that is easy to understand.			-.690			
In my science class we learn about scientists and what they do.			-.620			
My science teacher gives us quizzes that we mark to see how we are going.			-.609			
My science teacher marks our work and gives it back quickly.			-.564			
My science teacher lets us choose our own topics to investigate.			-.552			
We learn interesting things in science lessons.			-.512			
Science lessons are exciting.	.304		-.486			

- Self-Efficacy scale
- 2018
- University of North Carolina Chapel Hill

Also teaching.

Pattern Matrix[a]

	Component 1	Component 2
After I finish this course I feel that I can succeed if I take the next level of astronomy class	.937	
I can explain how spectroscopy works	.808	
I can do astronomy	.805	
Most astronomy concepts are easy to learn	.772	
I can explain how the length of the day changes with latitude	.735	
I feel that I can, with relative accuracy, visualize the universe at all different scales	.710	
I can do the math needed in an introductory astronomy course	.704	
I can explain why stars are different colors and brightnesses	.694	
I can learn math well enough to be an astronomy major	.689	
I can measure angles between objects in astronomical images	.588	
I would be able to use parallax measurements of objects within our solar system to measure the astronomical unit	.574	.313
I can distinguish between a globular cluster and galaxy in a telescope image	.558	
I have a good grasp of what objects exist within and around our galaxy	.550	
The current scientific model of the origin and evolution of the universe is clear to me	.548	
Given appropriate information about standard candles (RR Lyrae, Cepheids or Type 1a Supernovae), I can calculate their distance	.538	
I can explain how eclipses occur	.536	
I am able to request telescope images through a web-based portal		.869
Selecting different filters for a remote telescope observation is easy		.821
I can show someone how to request an image from a remote telescope using an online portal		.795
Adjusting the brightness and contrast levels in astronomical images is straightforward		.794
I can learn how to use a remote telescope		.780
I know how to use remote telescopes		.638
I could identify objects that are moving across the sky by examining a series of astronomical images		.606
Astronomers know how to use telescopes to take images of galaxies and nebula		.585
Astronomers need to be able to do complex math		.484
Explaining how variable stars change brightness over time is really challenging		.410
Astronomers have a solid grasp of space and time		.311

After analysis of the individual questions, a handful were discarded leaving these two factors which we call **Astronomy Self-Efficacy** and **Instrumentation Self-Efficacy**. Eight questions remain in the former, and 5 in the

Case Study

- Rich descriptions of the project activity through interviews with project personnel, curricula material, outputs of scientific research.

Career intentions / Science Identity

- A very boring straightforward career intention/interest survey.

- Rich interviews about science identity also embedded in their conception of teamwork, community of practice, social aspects.

What IS the DECRA?

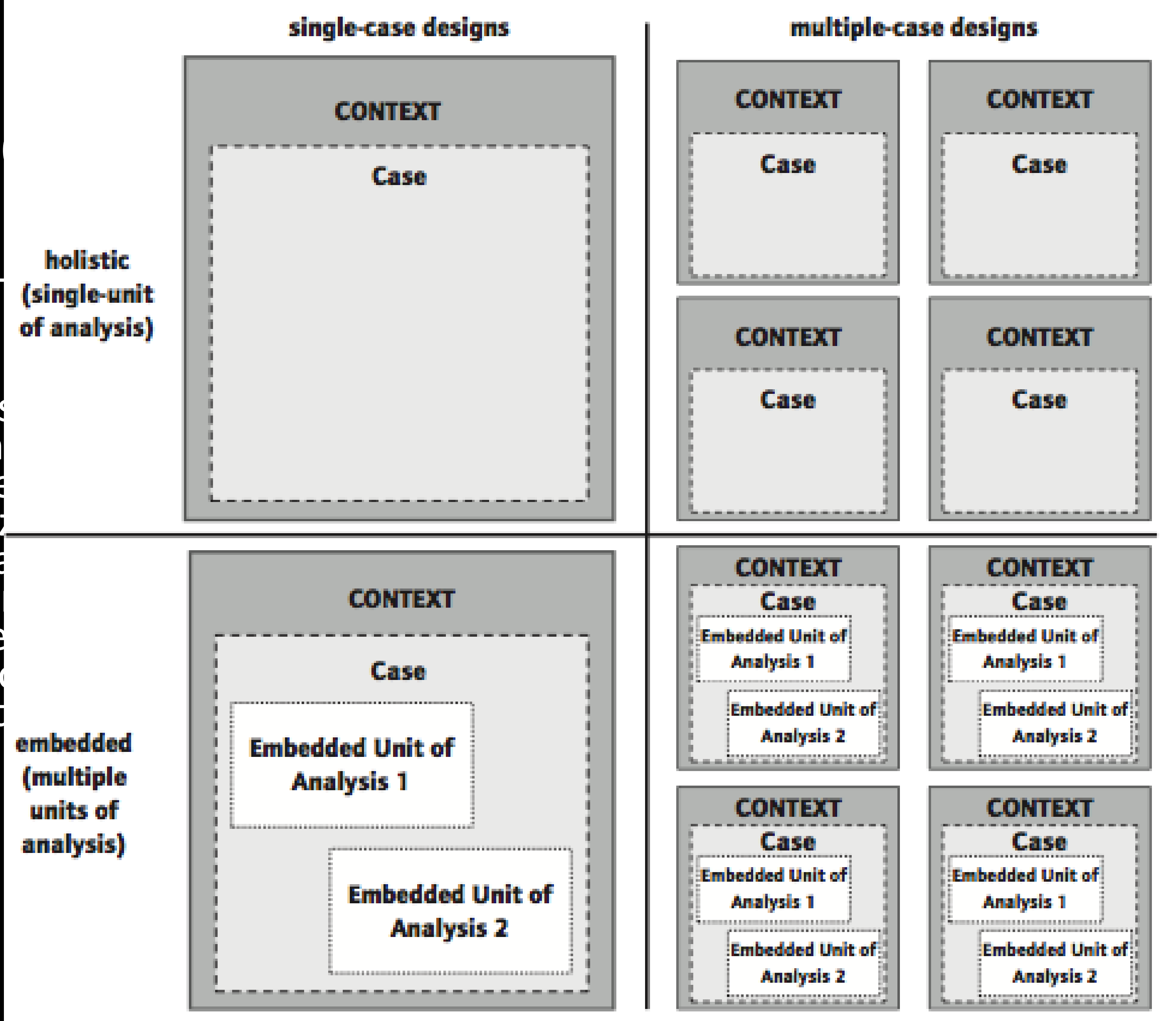
- Multiple Case Studies. – Type IV

- The Type 4 multiple case study design (Yin, 2014) will use homogenous comparable measurements at multiple times within multiple research experience programs. A case study design is chosen as ethical and practical constraints mean an experimental randomized control study is not feasible. It is also not desirable to decontextualise the teacher research experience programs from their sociocultural, economic and political milieu. Further, the population of teachers that undertake research experiences in astronomy each year is too small, the style of implementation too varied between projects, and the threats to validity too high to provide statistical power for a more quasi-experimental study based on a probability sampling logic. Hence, the research logic here is concerned with whether the claimed, but as yet poorly-tested, beneficial effects of teacher research experiences are replicated across different programs in a variety of contexts.

What IS the DE

- Multiple Case Studies. – T

- The Type 4 multiple case s comparable measuremen programs. A case study de an experimental randomiz to decontextualise the tea sociocultural, economic a that undertake research e style of implementation to too high to provide statist on a probability sampling whether the claimed, but research experiences are contexts.



Two models

- Pre/post – what occurs over the course of a research experience? Are these findings replicable across multiple cases?

- Post-only – this is more for theory building and checking than for causal/correlational aspects.

- External, Internal and Ecological Validity

Internal Validity

- Really only valid for true cause-and-effect relationships.
- Needs control over experimental conditions.

Internal Validity

- No Randomization
- No control group
- No control over location
- Mortality a given
- Learners ARE doing something novel

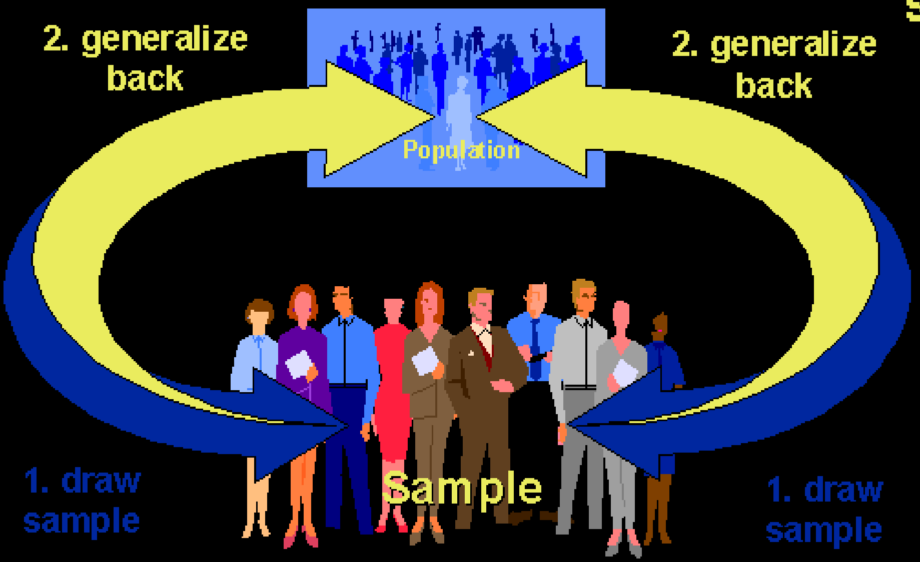
Threat	Description	How to minimize the threat
Subject characteristics	Differences among participants at start of study	Randomization
Selection bias	Biased assignment to experimental groups	Randomization
Maturation	Changes in participants over time unrelated to particular events	Randomization
History	Unplanned events unrelated to the intervention that might impact outcome	Concurrent control group
Instrumentation	Changes in scoring rubric or instrument calibration, including rater fatigue	Control group
Regression to the mean	Participants selected or groups assigned based on high or low performance will be closer to average upon subsequent testing (Bland and Altman 1994)	Control group (assignments not based on baseline performance)
Testing	The effect of taking a pretest on study outcomes (familiarizes participants with questions on posttest, stimulates learning/ study to the test, and heightens awareness of intent of study)	No pretest[a]
Mortality (loss to follow-up)	Participants leave study	Prevent loss; collect information on those lost[a]
Location	Differences between groups in the environment or available resources	Collect information on potential difference[a]
Participant attitude and motivation	Learners involved in something they consider novel, or who are being	Blind participants to study hypothesis[a]

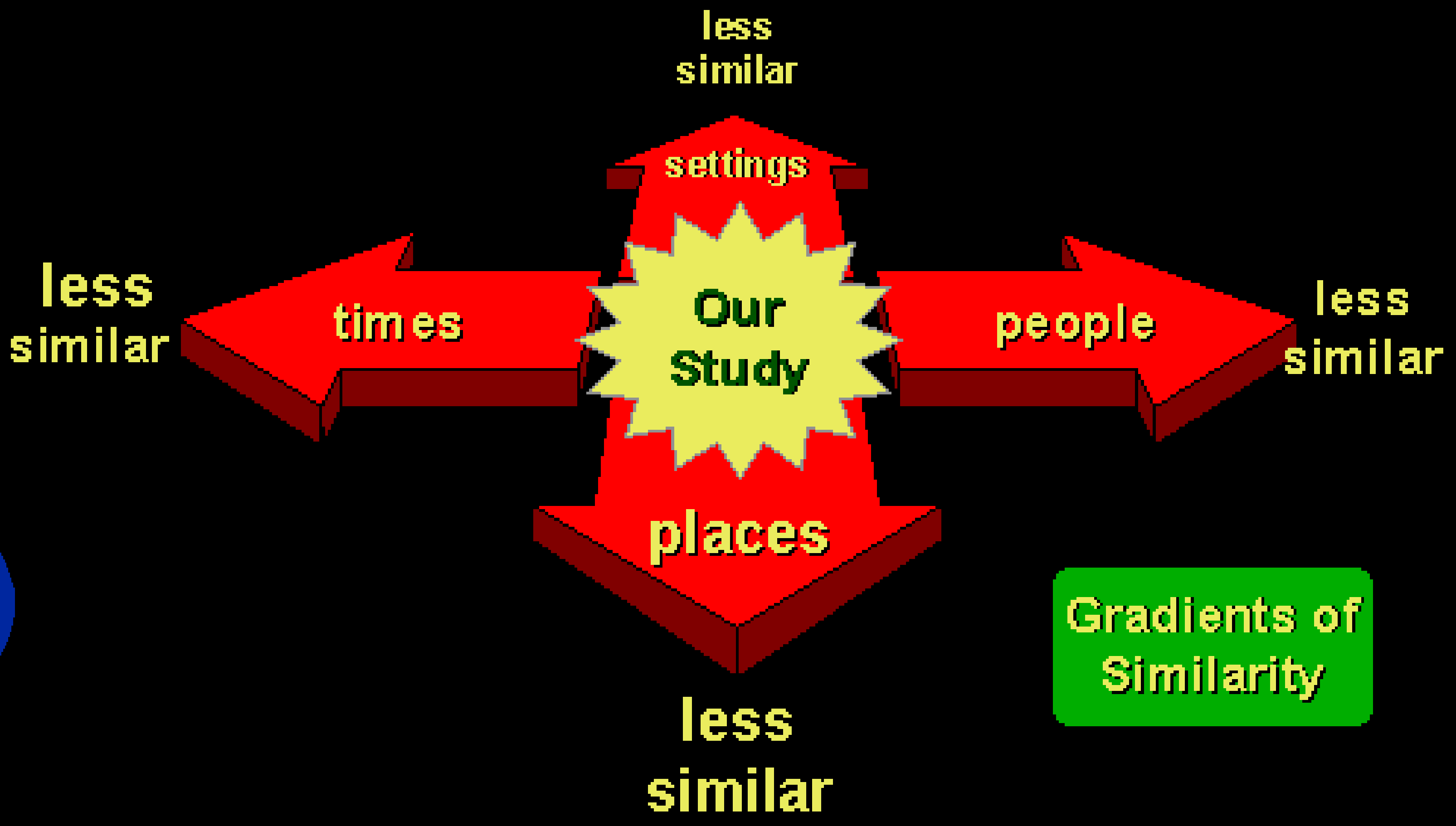
External Validity

- Validity of generalizing the sample data to the entire population.

External Validity

- Validity of generalizing the sample data to the entire population.
- We do not have it!





- External, Internal and Ecological Validity

Ecological Validity

- Some call it a sub-type of External Validity. Some separate it.

- Can a study be generalised to naturalistic situations? (Other interpretation: How closely do experimental conditions mirror real conditions?)

- In this study – are the findings from the logic model *replicated* across multiple real-life cases that vary in context?

External vs Ecological Validity

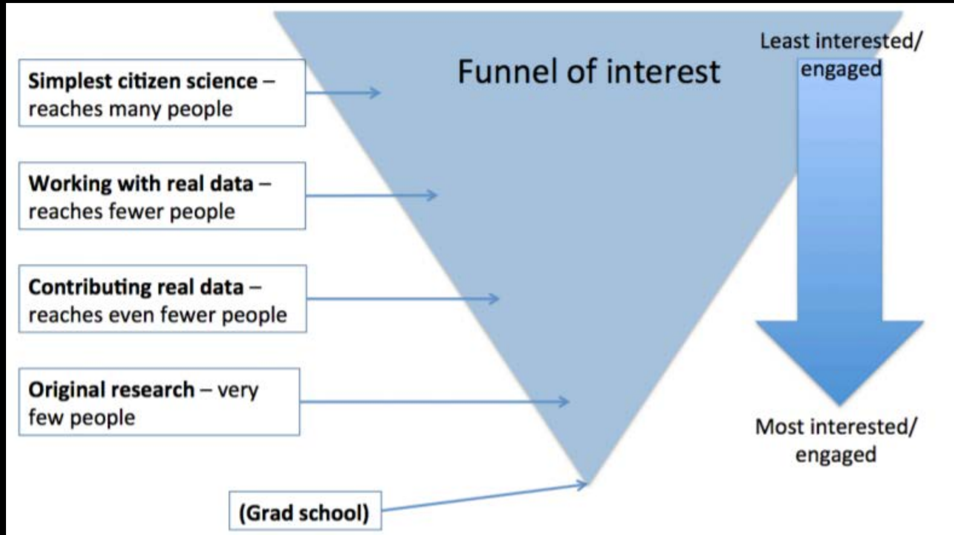
- External Validity asks that you assume a randomized group of 1000+ participants (+control) represents the larger population as a whole. It's friend, Internal Validity, says that it is a real effect.

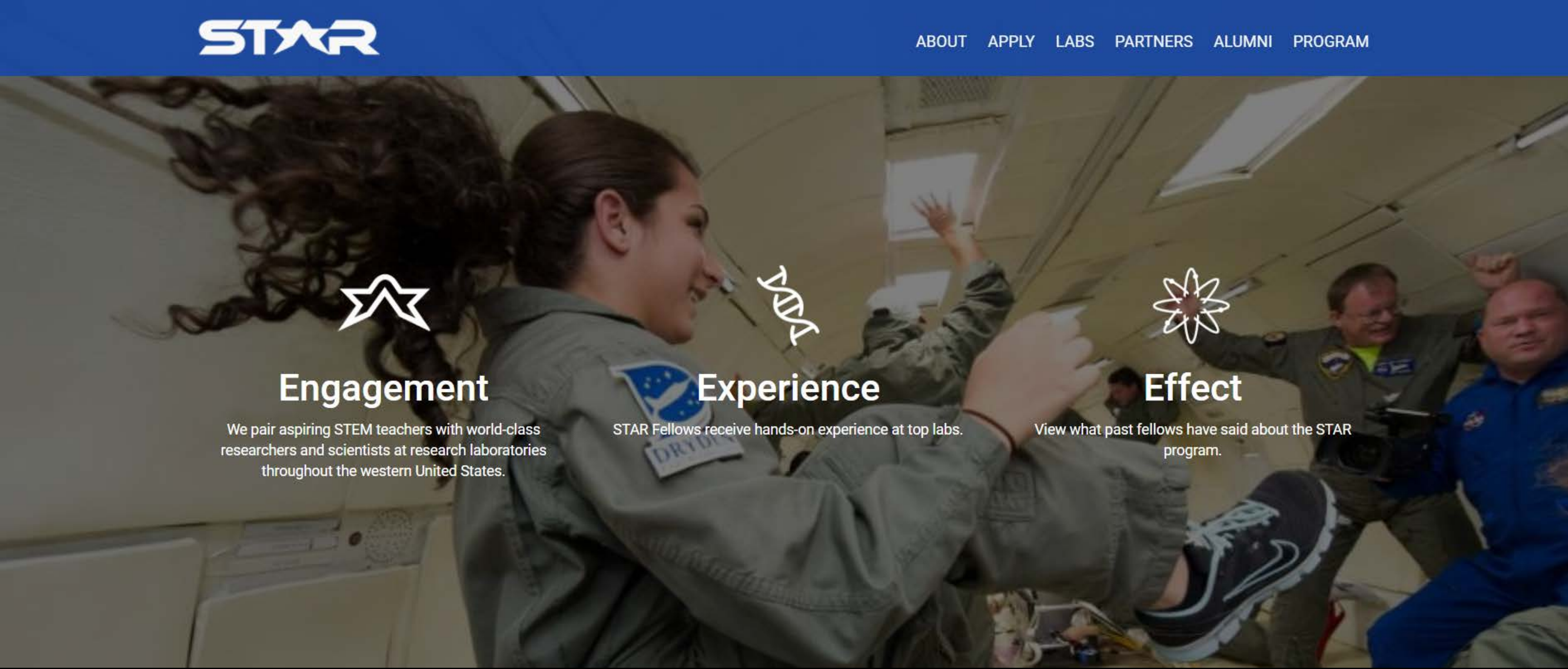
- WEIRD - **W**hite, **E**ducated, **I**ndustrialized, **R**ich, and **D**emocratic.

- Ecological Validity asks whether the results are *replicable* in *real-life* situations.

Targets

- Still WEIRD - **W**hite, **E**ducated, **I**ndustrialized, **R**ich, and **D**emocratic.
- Projects and sizes and shapes. Both in the USA and Australia
- Ones that looked good but weren't, then those we picked up along the way.
- Ethics and timing as a frustrating hurdle!





- 600 alumni
- 50 participants / year – each in different contexts
- 9 week program paid

Lawrence Livermore National Laboratory

SLAC National Accelerator Laboratory

Pacific Northwest National Laboratory

Sandia National Laboratories

NREL National Renewable Energy Laboratory

Department of Defense

Air Force Research Laboratory

National Aeronautics and Space Administration (NASA)

Ames Research Center

Armstrong Flight Research Center

SOFIA Stratospheric Observatory for Infrared Astronomy

NASA JPL Jet Propulsion Laboratory California Institute of Technology

National Science Foundation (NSF)

LIGO Laser Interferometer Gravitational-Wave Observatory

National Optical Astronomy Observatory

NCAR National Center for Atmospheric Research

National Oceanic and Atmospheric Administration (NOAA)

NOAA Southwest Fisheries Science Center

NOAA Earth System Research Lab

University

EOS center

Biosphere 2 – The University of Arizona

The California State University

Clean Energy Institute – University of Washington

UW MEM·C – Molecular Engineering & Materials Center

Seattle Pacific University – GENI Project

University of Washington – UW Physics-Seidler X-Ray Spectroscopy Lab

Fred Hutch – Cures Start Here™

Private and Non-Profit

SETI Institute

MBARI

Institute for Systems Biology – Revolutionizing Science. Enhancing Life.

- Caltech – 8 to 20 teacher participants per year.
- $30,000 cost per teacher.

ATARP?


Australian SKA Pathfinder (ASKAP)
An innovative CSIRO project to deliver a world-class radio telescope and SKA precursor instrument.
ASKAP will be a fast survey instrument with a wide field of view of 30 square degrees at 1.4 GHz, provided by innovative chequerboard phased array feed receivers.

- 50 instructors, 200 students in 2019 through UWyoming
- 12 teachers in 2019 through CEO Parramatta

Las Cumbres Observatory

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InStAR Online Astronomy Research Seminar

Beginning in Summer 2018, InStAR will begin offering online versions of the Astronomy Research Seminar to undergraduate college students, interested college faculty, citizen scientists, and anyone interested in learning how to perform authentic scientific research.

Enrolled students in these non-accredited courses will receive the appropriate astronomical datasets, learn how to understand the quality and characteristics of their datasets, learn how to reduce the data with provided astronomical software, receive guidance on how to interpret the resulting data products, and contribute to a team-led publication that will be submitted to an appropriate scientific journal. Course enrollment is limited to 20 students.

There will eventually be four versions of the online Seminar available:

- Double Star Astrometry (8-week course).
- Speckle Interferometry (12-week course)
- Exoplanet Photometry (12-week course).
- Solar Astronomy Research (12-week course).

California State University - Monterey Bay (20)

Sonoma State University (20)

Online Seminar (20)

BRIEF (20)

Where to now?

- Instrument construction complete.

- Major data gathering period is currently occurring.