

# Peer Instruction in Mathematics at Sacramento State

S. Ghosh Hajra, A. Higgins, M. Krauel,  
K. Olson, V. Pigno, & C. Shanbrom

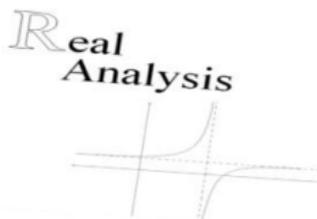
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STATE

CSU Math Council Colloquium  
January 22, 2021

# Peer Programs in Mathematics and Science



- Intro (V. Pigno)
- Commit to Study (A. Higgins, J. Paradis)
- Math Lab (K. Olson)
- Peer Assisted Learning Program (M. Krauel, J. Lundmark, V. Pigno, & C. Shanbrom)
- Real Partners for Real Analysis (S. Ghosh Hajra, A. Higgins)

# A Small Sample of Peer Programs at Sacramento State

- School of Nursing Mentoring
- The Go-To Crew and First Year Experience
- Improve Your Tomorrow U at Sac State
- Science Educational Equity Ambassadors
- Graduate Preparation Academy
- Community Engagement Center Volunteer Ambassadors
- The DEGREES Project
- Team Study Abroad
- Peer Mentoring in Sociology
- The Serna Leaders
- Peer & Academic Resource Center
- Odyssey Mentoring
- Guardian Scholars Program
- Sankofa Intercultural Competence and Leadership Skills
- College Assistance Migrant Program Leaders
- Dream Leaders
- Psychology Prospects Peer Mentoring
- Writing Fellows
- Math 12 Mentors



# Notable Peer Programs in Mathematics



- Peer and Academic Resource Center (Director: T. Jordan)
  - One on one peer tutoring
  - Peer lead SI workshops
  - Peer Advising
- Information: <https://www.csus.edu/parc>
- Contact: [parc-01@csus.edu](mailto:parc-01@csus.edu)



# Notable Peer Programs in Mathematics



- The Louis Stokes Alliance for Minority Participation (LSAMP) Math Honors Program.
  - Summer Bridge Program
  - Stretch Precalculus course with peer led workshops
  - Cohorted Calculus courses for LSAMP
  - LSAMP Math Honors Program was incorporated into Peer Assisted Learning (PAL) program
  - LSAMP at Sacramento State is currently focused on undergraduate research experiences



# Commit to Study (C2S)

One-on-one peer mentoring in study skills for math and science classes

- Peer mentors are undergraduate who are trained to help all students reach their full potential.
- Peer mentors work with students on developing study skills for science and math classes.
- LASSI (Learning and Study Skills Inventory)  
(1) Time Management, (2) Using Academic Resources, (3) Motivation, (4) Attitude, (5) Anxiety, (6) Test-Taking Strategies, (7) Information Processing, (8) Selecting Main Ideas, (9) Concentration, (10) Self-Testing
- First Meeting: Assessment  
Follow-up Meetings: Progress on Goals
- Fall 2020 data:  
**First Appointments:** 282 students  
**Follow-up Appointments:** 264 (some duplicates)  
**Average GPA:** 2.79  
**Majors:** pre-Bio (46%), engineering, (21%), chem (6%), other (27%)

Abigail Higgins, Interim Director, [abigail.higgins@csus.edu](mailto:abigail.higgins@csus.edu)





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# MATH LAB

- The Math Lab is a student staffed walk-in tutoring center focused on lower division math courses
  - Plans are being talked about to add a component for upper division courses as well
- Open room with large tables for students to work
  - Flags for if students have questions
  - One section is “reserved” for College Algebra students and is where their instructors usually hold their office hours



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# MATH LAB

- Tutors are graduate students in the Math program and undergrads who have completed the lower division math courses (mostly math majors but some engineers and CS majors as well)
- Math 198 is strongly encouraged to new tutors in their first semester of tutoring. It is a class for tutors and TAs who are teaching for the first time that provides support and discusses pedagogy, how to handle different situations, and classroom observations among other activities





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VIRTUAL

# MATH LAB

- Virtual Math Lab run through Zoom
  - Students are put in breakout rooms individually or in groups where they can work and notify the tutors if they get stuck or have a question
  - May continue once we return

# Peer Assisted Learning at Sacramento State

Matt Krauel, Vincent Pigno, and Corey Shanbrom

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California State University, Sacramento  
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# Peer Assisted Learning at Sacramento State



- PAL is a curricular structure that encourages cross-year support among students in science and math gateway courses.
- Based on Peer-Led Team Learning (PLTL) model.
- Encourages students to learn co-operatively under the guidance of undergraduate Facilitators.
- Facilitators have been successful in the same course they facilitate, and are highly trained in group facilitation and pedagogy.

- Increase student academic success in gateway STEM courses.
- Create a sense of community and promote collaboration (rather than competition) among students.
- Provide leadership and research opportunities for undergraduates.

# Program Structure

Center for Science and Math Success (College of NSM)



PAL Faculty Leadership:

Drs. Lundmark (Bio), Shanbrom (Math), Krauel (Math), Pigno (Math)



3 Supervisory Facilitators, 1 per discipline



14 Lead Facilitators, 1 per course



Over 60 Facilitators serving Math, Stat, Phys, Chem, Bio courses

# Fall 2019 Facilitators

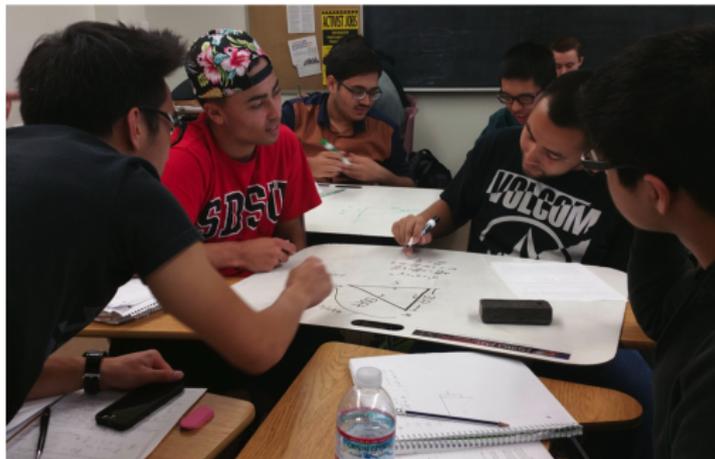


# Inside a PAL Classroom



- Each PAL section is comprised of 10-15 students and 1 PAL Facilitator, and is directly connected to a primary STEM course.
- Each section meets for 2 hrs/wk and runs as an independent, 1-unit class graded credit/no credit.
- Enrollment is voluntary.  
Marketing: PAL is for *everyone*, it is *not* remediation.

# Inside a PAL Classroom



- Small groups (3-4 students) work around a whiteboard or chalkboard, taking turns working problems written by faculty.
- *One* active marker per group.  
Facilitator makes sure it cycles through the group.
- Facilitators do not teach, tutor, or even confirm answers.  
They do ask scaffolding questions.

# Facilitator Duties

- Facilitators typically work 8 hrs/wk:
  - 2 hrs = running their section
  - 2-3 hrs = regular office hours in the PALace (open to all)
  - 3-4 hrs = attending primary course lecture

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- Additional hours include:
  - Multi-day trainings before each semester.
  - Review sessions (open to all)
  - Flex hours for professional development/trainings (Dreamer Ally, Safe Zone, etc.)
  - Extra hours for Lead and Supervisory Facilitators

- All Facilitators take Honors Seminar Peer Learning (NSM 197):
  - Upper division 2-unit graded course, Wed nights, 2 hrs
  - First hour: run-through upcoming worksheets (with faculty help if needed)
  - Second hour: additional trainings (self-efficacy, growth-mindset, cultural competency, metacognition, etc.), guest speakers, PAL panels, parties (PALoween, PALentines Day, PALcademy Awards), and ...

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- Action research projects:
  - Cross-disciplinary teams of  $\sim 5$  Facilitators
  - Fall: propose ideas, form teams, develop methodology using backwards design, background and literature
  - Spring: conduct research, analyze results, create poster

# Poster Session

Culminates in PAL Research Poster Session: catered fancy event drawing dignitaries like President, Deans, etc.



# History

- Started Spring 2012, one section of Chemical Calculations.

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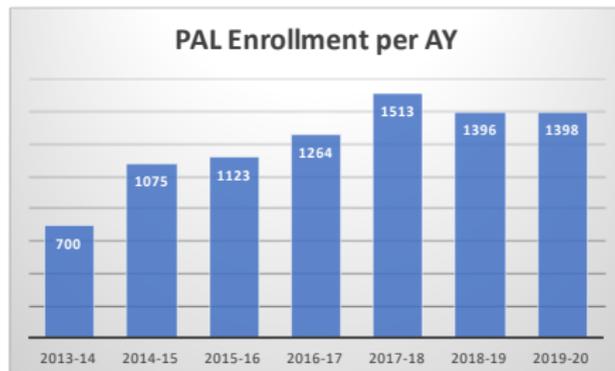
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  - Intro Stat
  - Gen Phys
  - Chem Calc, Gen Chem 1, Gen Chem 2
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  - No Barriers to Success Squad
  - The Grace Project

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These programs have resulted from *student* ideas. Our Facilitators, often via their research projects, continually improve the program and generate new programs. Research projects also lead to grants, conference talks and posters, and even publications.

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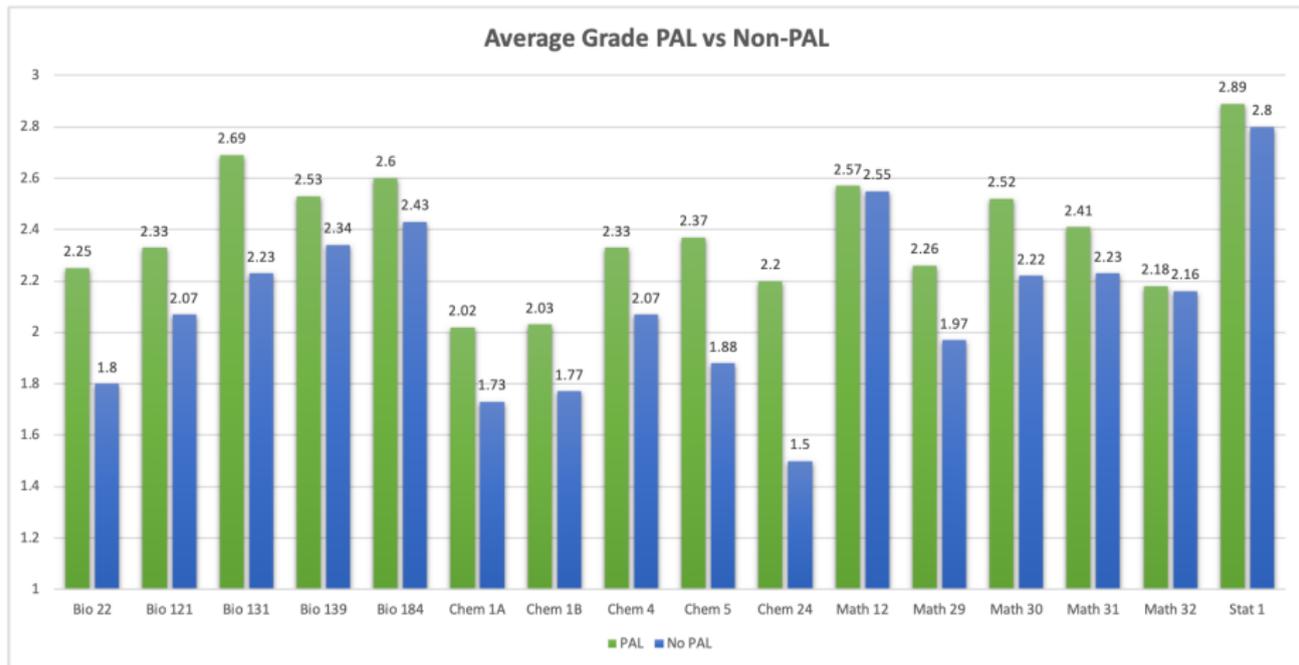
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  - NSF STEP grant (2011, DUE 1068383), \$2 million; started program
  - NSF S-STEM grant (2016, DUE 1644273), \$1 million; added upper division biology courses
  - NSF HSI STEM grant (2020, DUE 1953752), \$2 million; started Engineering PAL and Hornet Leadership Program

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- Now mostly funded by University Academic Affairs, largely thanks to student lobbying. The rest is picked up by various grants (eg. HSI, Student Government).

# Raw data: avg course GPA



On average, students in the PAL program earn a 15% higher grade than students who are not in the program.

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- Employing propensity score matching techniques since PAL is an opt-in program and “good students do what good students do.”
- In general, PAL students match the greater Sac State community in social and academic demographics.
- Analysis completed for bio classes shows that the raw numbers *underestimate* the PAL effect. Eg: in Bio 121 the raw grade bump is .21 grade points, while the propensity score matching shows a bump of .35 grade points.

Detailed statistical analysis for Bio 121, including R code samples, available at [csus.edu/pal](https://csus.edu/pal) under “PAL Data.”

## Data Cleaning and Feature Engineering

Creates new variables: delay since high school and cumulative percent of units passed. Collapses sparse categories and other miscellaneous clean up of data. Sparse categories can cause complete separation in logistic regression and are only predictive for a few students.

```
yr.course.taken = as.numeric(gsub(".*{0-9}(4)", "\\1", bio.dat$coh.term))

bio.dat$delay.from.hs = ifelse(is.na(yr.course.taken) & is.na(bio.dat$hs.grad.yr), yr.course.taken-bio.dat$hs.grad.yr, NA)

sum(is.na(bio.dat$delay.from.hs)) #1864 missing values

## [1] 1864

# remove 106 students who did not complete PAL
bio.dat=subset(bio.dat, palN!=1)

#recode palN to factor with 0/1 levels
bio.dat$palN = ifelse(bio.dat$palN==2, 1, 0)

#clean up category names in s.rmd and e.rmd
bio.dat$e.rmd[bio.dat$e.rmd=="Not Remedial\\nln Math"]="Not Remedial in Math"
bio.dat$e.rmd[bio.dat$e.rmd=="Remedial\\nln Math"]="Remedial in Math"

bio.dat$e.rmd = droplevels(bio.dat$e.rmd)

bio.dat$e.rmd[bio.dat$e.rmd=="Not Remedial\\nln English"]="Not Remedial in English"
bio.dat$e.rmd[bio.dat$e.rmd=="Remedial\\nln English"]="Remedial in English"

bio.dat$e.rmd = droplevels(bio.dat$e.rmd)
table(bio.dat$e.rmd)

##
## Not Remedial in English    Remedial in English
##           15474                3704

# create feature, proportion of cumulative units taken that were passed
bio.dat$cum.percent.units.passed = bio.dat$tot.passed.prgres.start/bio.dat$tot.taken.prgres.start

# collapse sparse categories
bio.dat=group_category(data = bio.dat, feature = "load.code", threshold = 0.05, update = TRUE)

table(bio.dat$load.code, PAL=bio.dat$palN, droplevels(bio.dat$course))
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table(bio.dat$load.code, PAL = bio.dat$palN, droplevels(bio.dat$course))
```

Analyses for remaining classes in progress, first results received today!

# Thank you!

Thank you for listening!



[www.csus.edu/pal](http://www.csus.edu/pal)

# Real Partners for Real Analysis

January 22, 2020

Abigail Higgins and Sayonita Ghosh Hajra

California State University, Sacramento

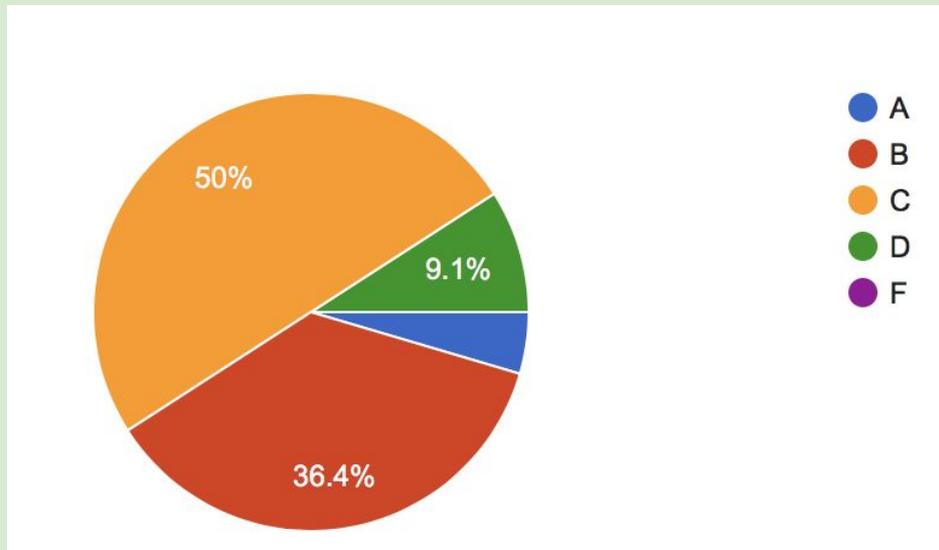
# In Advanced Undergraduate Mathematics Courses...

- <sup>1,2</sup> Lecture (“chalk talk”) is the predominant mode of instruction in advanced mathematics courses in the United States and internationally
- <sup>3</sup> Students have difficulty with the formal nature of the content

- Little academic support available
- Content and style (proof-writing) require new study techniques

<sup>1</sup>Fukawa-Connelly et al., 2016, <sup>2</sup>Artemeva & Fox, 2011, <sup>3</sup>Alcock & Simpson, 2002

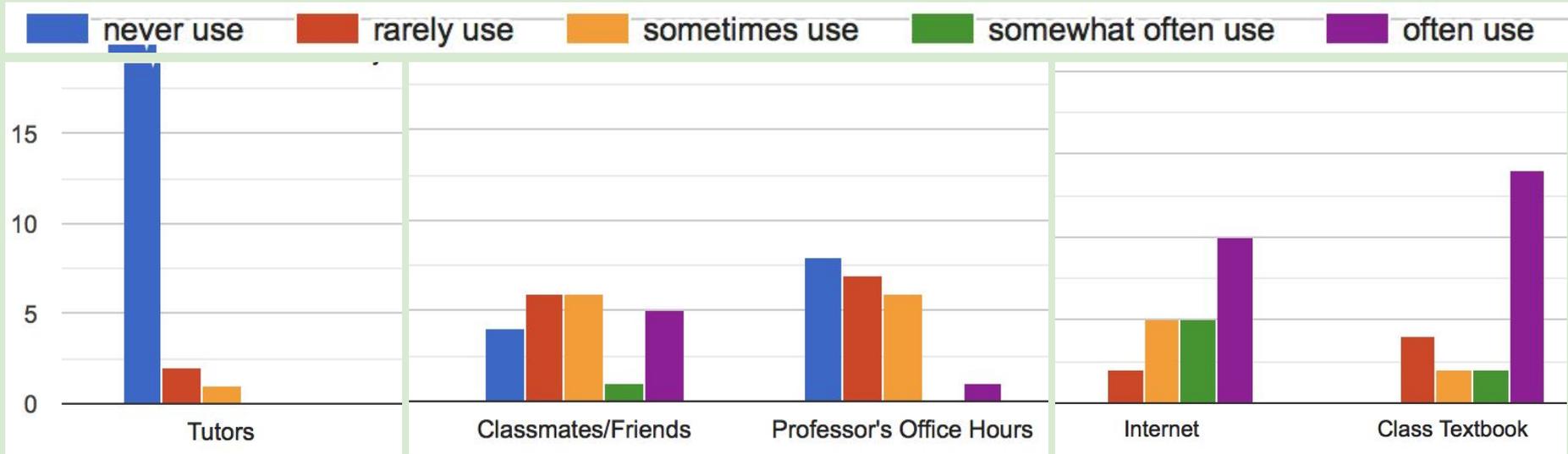
# What grade do you expect to earn in the real analysis course?



# In Online Modality... Teaching is hard!

- Hard to foster classroom community
  - Low student-to-student interaction
  - Low student-to-instructor interaction
- Difficult to gather formative assessment
- More challenging to implement active-learning strategies

# Which resources students using?



Limited academic support

Limited Course Engagement

No interactions

# In undergraduate advanced mathematics classes...

## Challenges

- Each student brings a unique set of talents and learning needs.
- Students tend to be passive during class
- Students typically do not share specifics about their struggles in the course.

## Goals

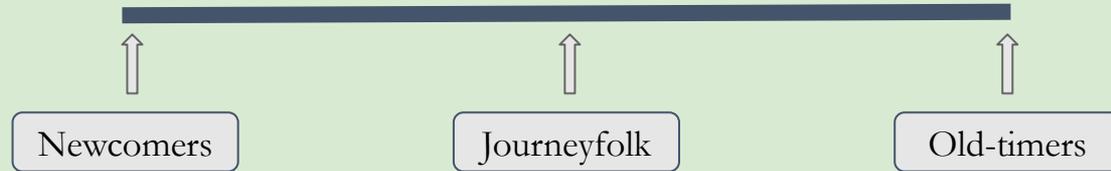
- Leverage students' talents/learning needs to create inclusive classroom.
- Increase student participation.
- Students provide feedback on their learning experiences.

# Community of Practice

*Situated Learning*  
(Lave & Wenger, 1991)

- “Learning involves the construction of identities,” p. 52
- Community of Practice
- Legitimate peripheral participation

“Rather than a teacher/learner dyad, this points to a richly diverse field of essential actors and, with it, other forms of relationships of participation.” p. 56



## Real Partners Program Objectives:

- Create inclusive learning community
- Promote student growth

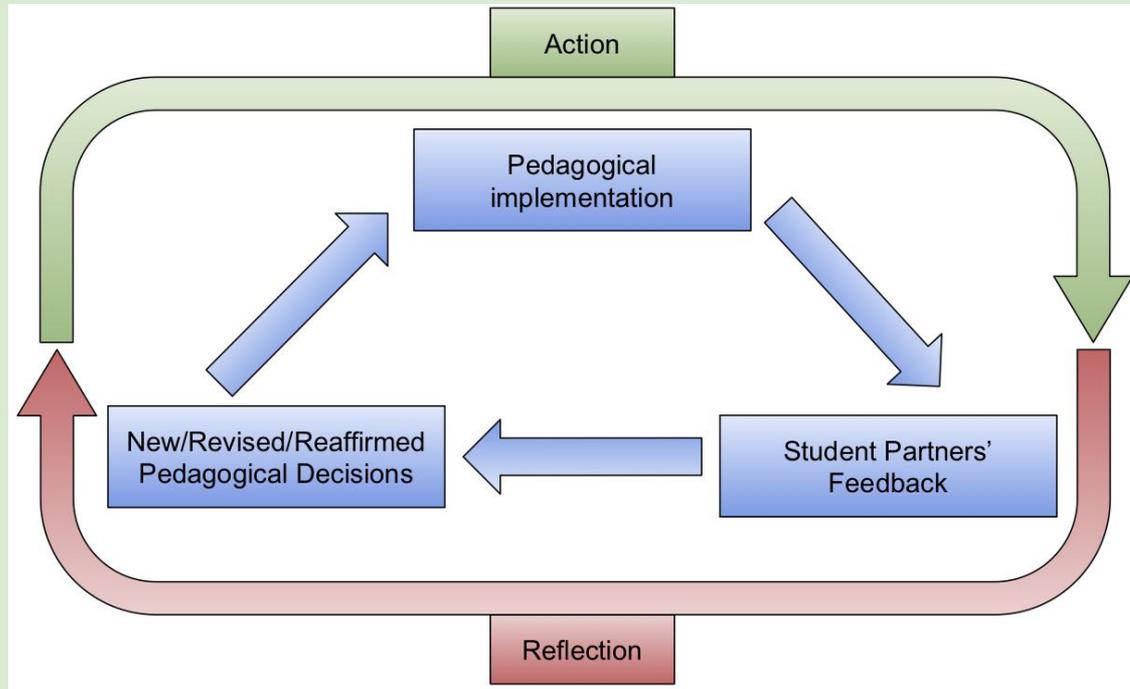
## Achieve these objectives by:

- Actively involving students in shaping the course.
- Lifting the curtain: allowing students to see the process of developing and delivering a course.
- Developing metacognitive skills.
- Refining communication skills and encouraging active community participation.

## Real Partners Program at Sac State

- Introduced in Fall 2020, Supported by DHSI INSPIRE 2020-2021 Mini-grant
- Two Student Partners (SPs) were hired for 10 weeks in Fall semester and paid for their time/work
- Student Partners met with instructor and program directors weekly and held weekly office hours for their classmates

# How the Program Works



Alvarado, Ghosh Hajra, Higgins, 2020

## Examples of SP Feedback

### Validation of Existing Instructional Design

Instructor: “ ... So they tell me that, ‘Oh like in the class on Monday it’s good that you said this, because you know then some students, actually asked questions in the chat and other students responded in the chat, like so. You don’t even have to actually answer, students answer each other’s questions and so on.’”

### Suggestions from Student Partners

- Increase wait times after questions asked by the instructor
- Rephrase questions when no one is answering
- Ask for student help in completing the proofs
- Make videos available more often

# Program Assessment

## Data Collection

- Participants
  - 35 undergraduate students (2 Student Partners)
  - 1 instructor
- Student survey (administered in the 13th week)
- Student partner weekly reflections
- Pre-and post-semester interviews with instructor
- Post-semester interviews with student partners

# Lessons Learned & Spring Implementation Plans

## Fall Implementation

- Office hours: Feedback sessions
- One student survey administered in the 13th week
- Post-semester interview with Student Partners
- No interviews with other students

## Spring Implementation Plans

- Office hours: Study sessions
- Gather early- and late-semester student surveys
- Pre- and post-semester interviews with Student Partners
- Post-semester interviews with other students

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## Contact Information

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