Enduring attitudes of life science students towards physics and interdisciplinary learning

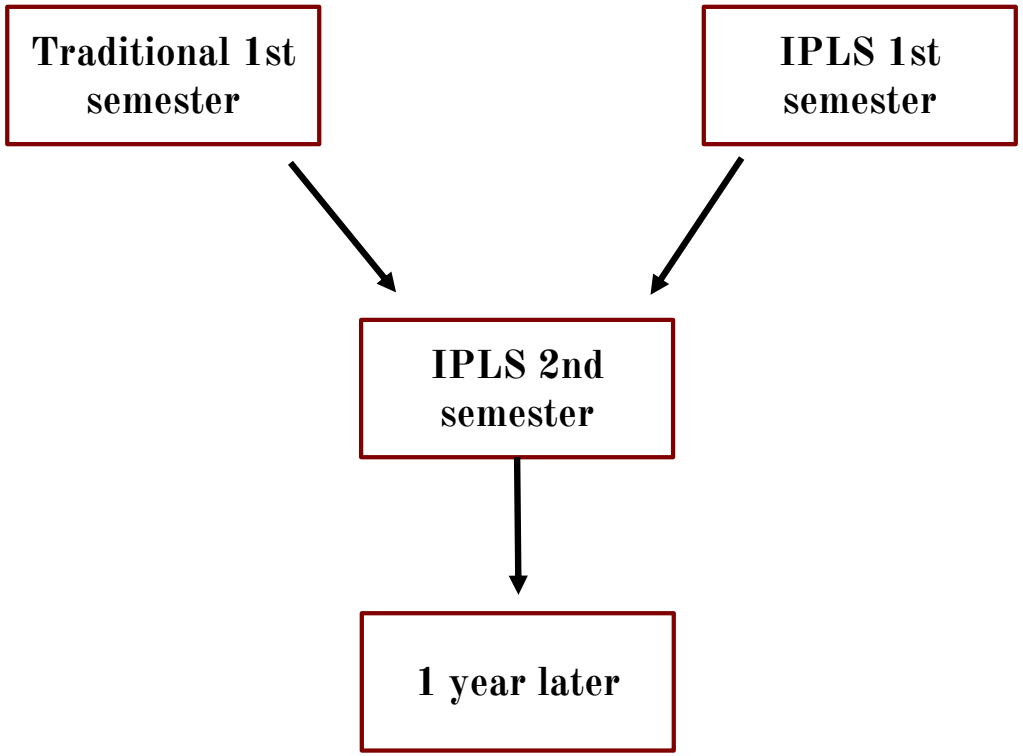
Haley Gerardi - Lake Forest High School
Swarthmore Class of 2017
Session ID# CB03

1710875

Guiding Question

How do attitudes of life science students towards physics and interdisciplinary learning develop during and persist after their IPLS experiences?

Timeline for students in our study



Data Sources

- Interdisciplinary attitude survey
  - Pre 2nd sem. IPLS → Post 2nd sem. IPLS → 1 year after 2nd sem. IPLS
- Pre and Post 2nd semester IPLS course interviews

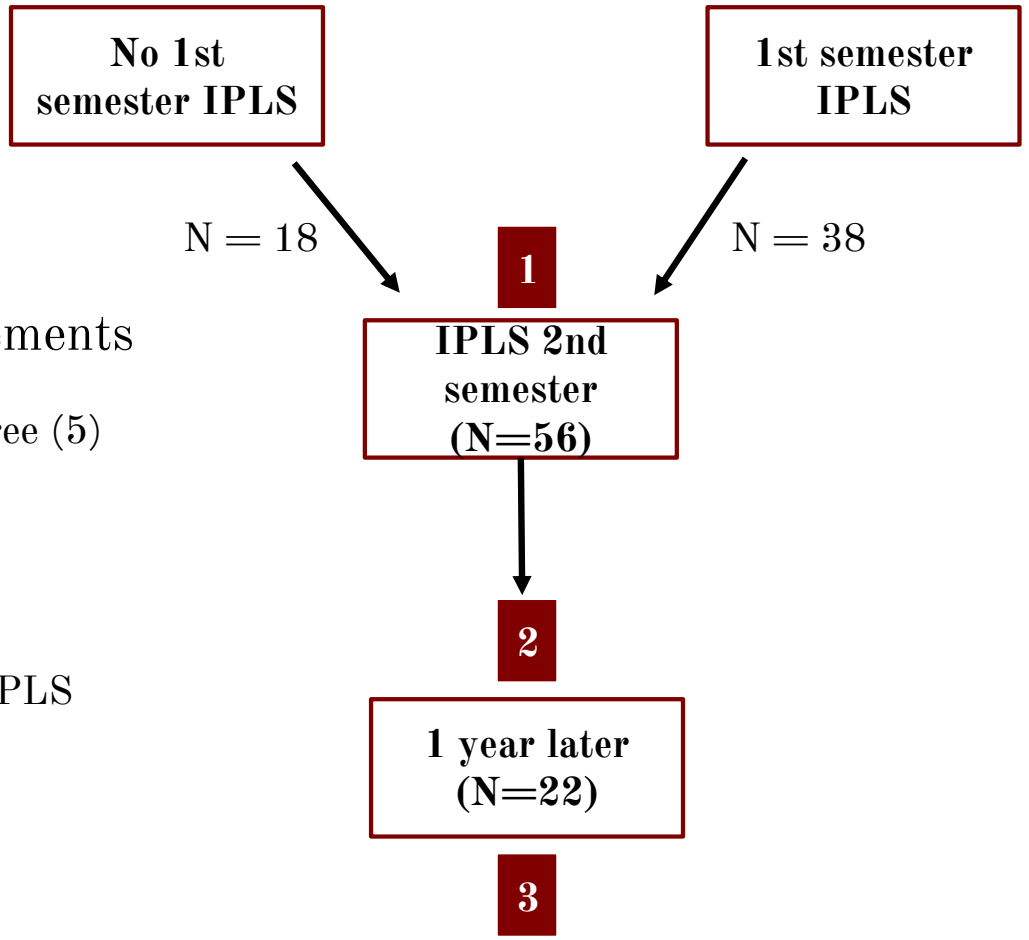
Survey Analysis

Assessed agreement with statements about relevance of physics and math to biology

- Attitudes improve from pre 2nd semester to post 2nd semester IPLS
- Attitudes persist 1 year after completing second semester IPLS

Survey Analysis

- Agreement with interdisciplinary statements
  - Scale strongly disagree (1) → strongly agree (5)
- Data collected at 3 time points
- Matched data (*N*=19)
  - Group of 19 is representative of 2nd sem IPLS



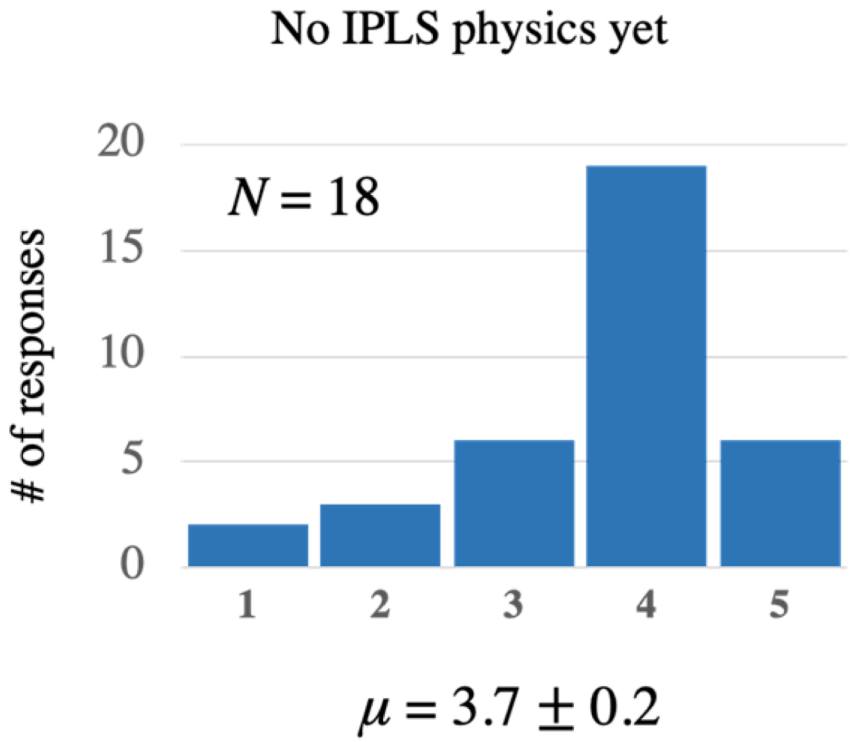
Interdisciplinary Statements: Physics and Bio

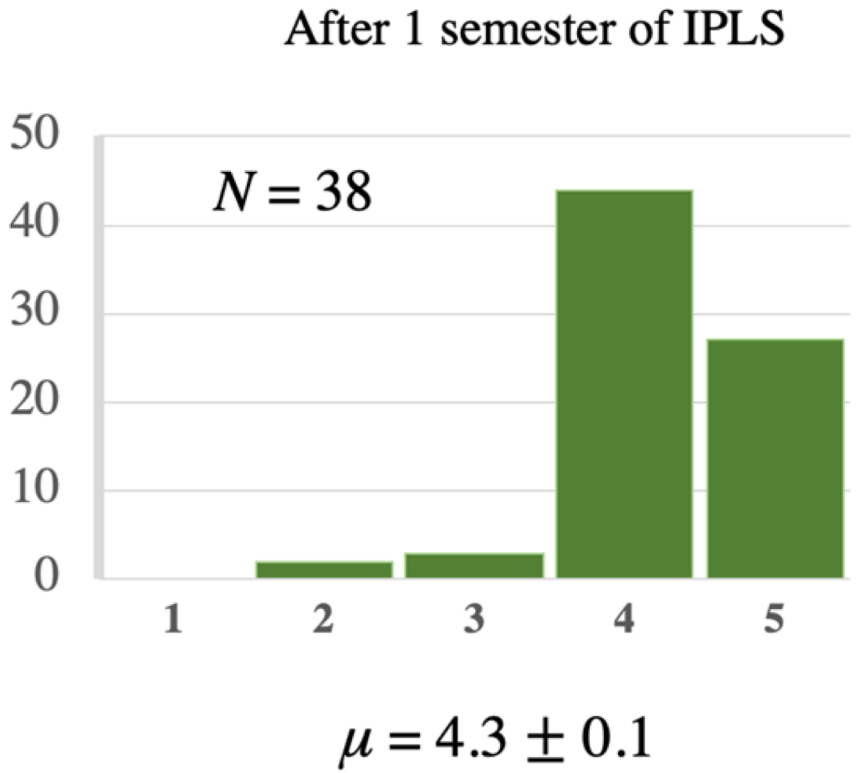
Physics is largely irrelevant for understanding biological processes

Physics helps me make sense of biological phenomena

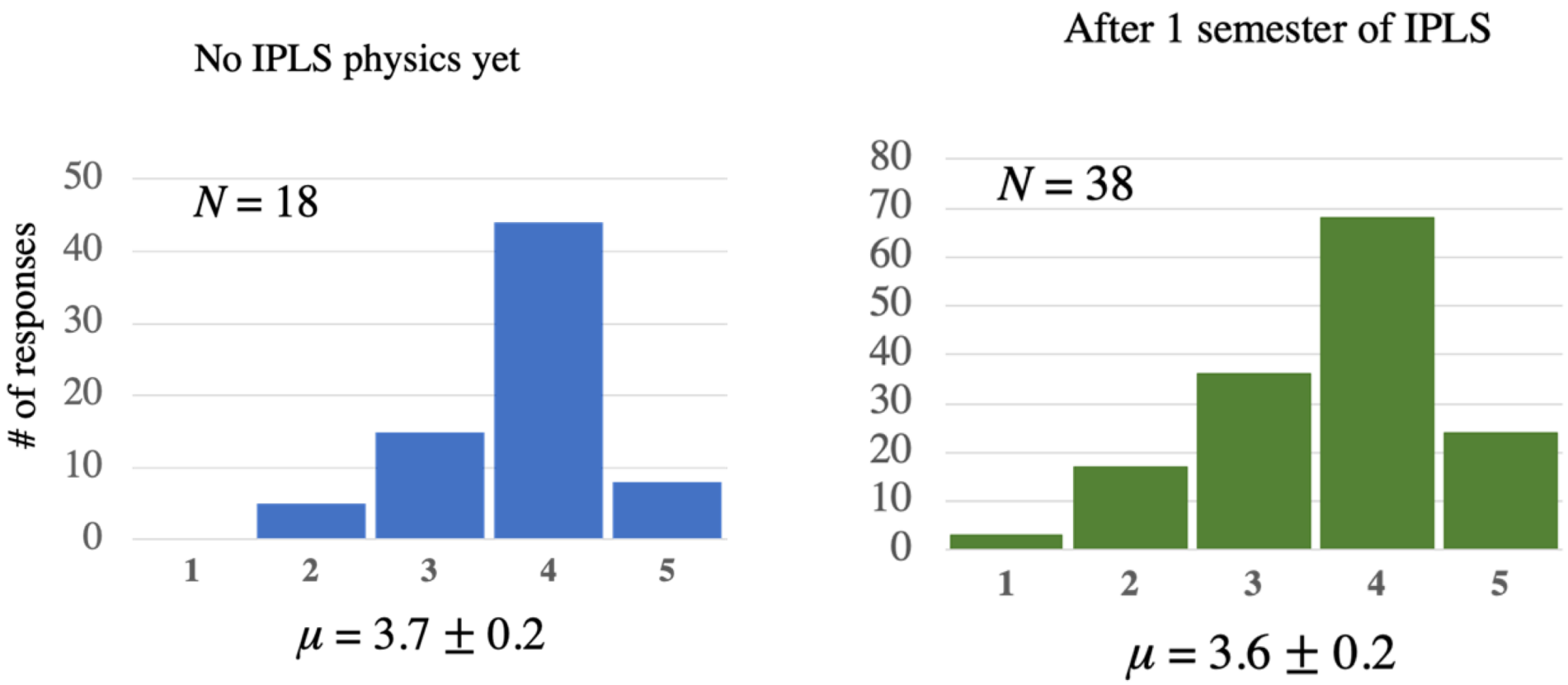
Kristi Lyn Hall, "Examining the effects of Students' Classroom Expectations on Undergraduate Biology Course Reform," Ph.D Thesis, University of Maryland (2013)

Attitudes about relevance of **physics** to biology after first semester



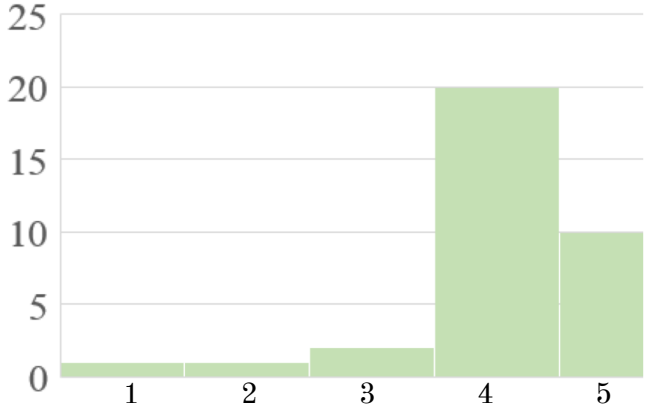


Attitudes about relevance of **math** to biology after first semester



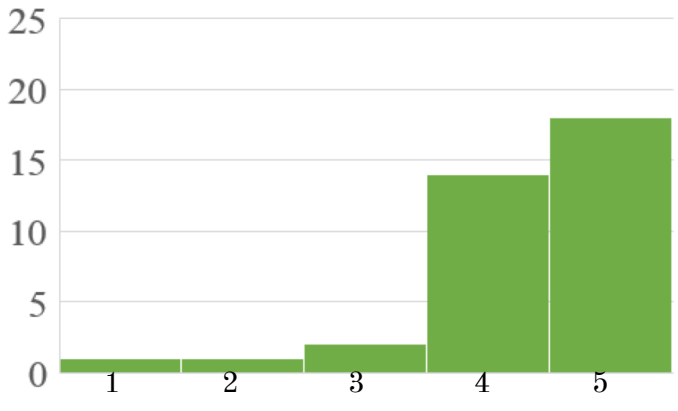
Growth and persistence of attitudes; Relevance of **physics** to biology (N=19)

Pre 2nd Semester IPLS



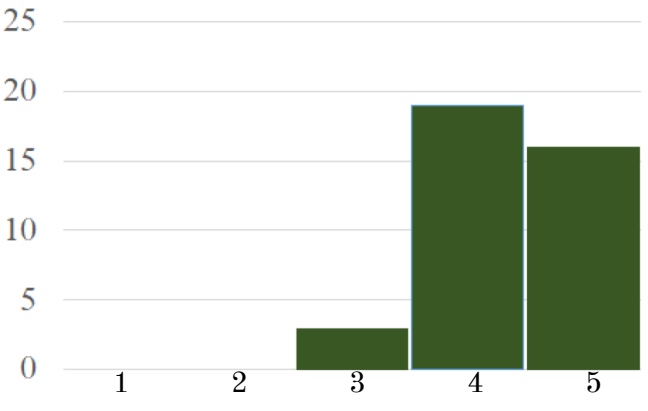
μ 4.1 $\pm$ 0.2 (SE)

Post 2nd Semester IPLS



μ 4.3 $\pm$ 0.2 (SE)

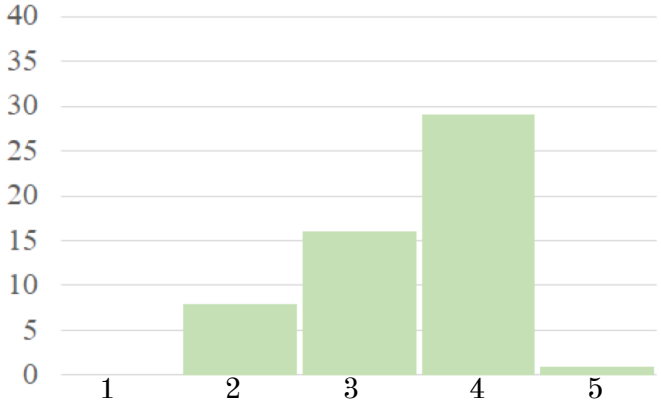
1 Year Later



μ 4.3 $\pm$ 0.1 (SE)

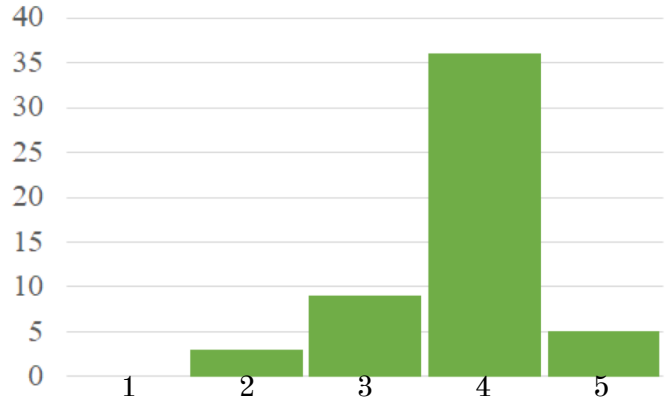
Growth and persistence of attitudes; Relevance of **math** to biology (N=19)

Pre 2nd Semester IPLS



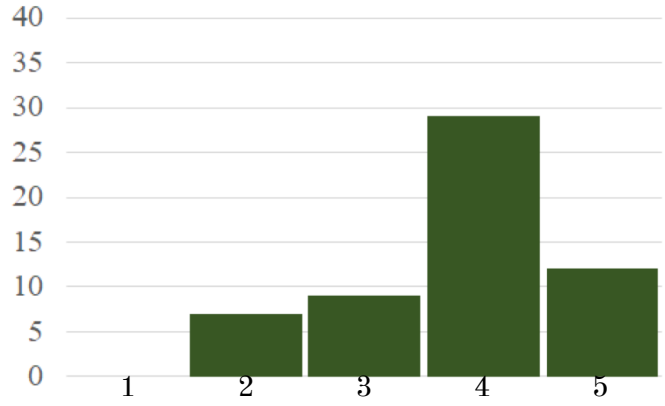
μ 3.4 $\pm$ 0.2 (SE)

Post 2nd Semester IPLS



μ 3.8 $\pm$ 0.2 (SE)

1 Year Later



μ 3.8 $\pm$ 0.2 (SE)

Interview Analysis

Unpacking the source of attitudinal shifts seen in survey results

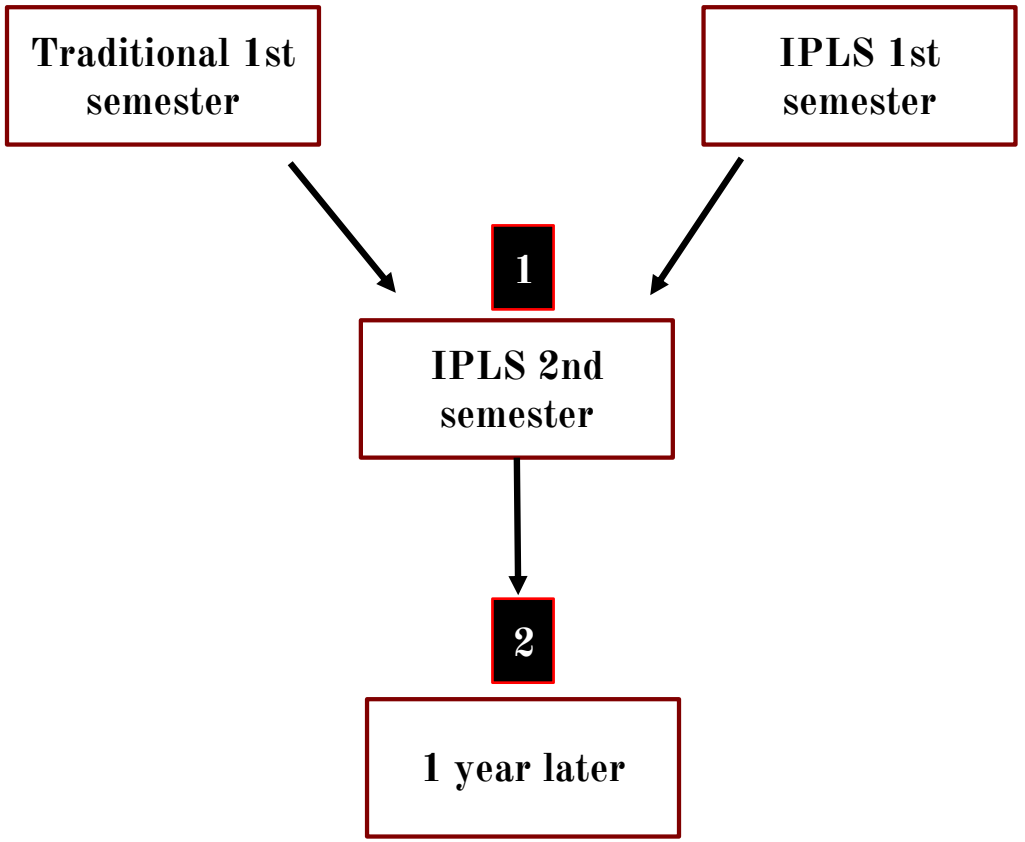
Three dimensions we found to be important in explaining attitudinal shifts

- Explanatory coherence
- Disciplinary Identity
- Messaging

Interview Analysis

1. 1st interview about 1st semester attitudes

1. 2nd interview about 2nd semester attitudes



Student examples: Explanatory coherence

Traditional

"...connections are possible but **I don't know how**" – Mercer

"...topics talked about in [Traditional Physics] were **divorced from [bio and chem]"** and "I just can't think how [Traditional Physics] content can be used in a medical context" – Trevor

"...missed opportunities..." – Maddie

IPLS

"...physics can be used to understand **same concepts** but **in a different light**" – Clara

"...what I most appreciated about [IPLS] was that it made clear a lot of physical phenomena that we take for granted in biology and chemistry. Really making it salient, and really **supported the way I learned in those other disciplines....**" – Clark

"Whatever approach you take will be improved by looking at it through physics, bio, and chemistry. **Combining all approaches will facilitate a better understanding"** – Trevor

Benjamin Geller, Chandra Turpen, and Catherine H. Crouch, "Sources of student engagement in introductory physics for life sciences," Phys. Rev. Phys. Educ. Res. **14**, 010118 (2018)

Student examples: Disciplinary Identity

Traditional

"Felt very much like **physics for engineers**... fewer connections were made to biology and chemistry, so that was a **little bit frustrating**" – Maddie

"Outside my comfort zone" & "not being comfortable in class" and goes on to describe the class as "**geared towards engineering students**" – Trevor

IPLS

" I'm a Chemistry major and so I felt that **this class really spoke to my interest**...It was really a class that I felt didn't just speak to my physics knowledge but also my chemistry background" – Maddie

"...**we were all just amazed** and really got an appreciation for physics as a whole... I will remember [IPLS] as a **big part of why I continue to pursue medicine** and why I didn't just give up on the career" – Clara

Student examples: Messaging

Traditional

"[**Traditional physics**] was, as you might know, is very much **developed for students** who are either **considering** physics or sort of the **engineering** type of degree so it's much more sort of couched in classical mechanics and how **things relate to sort of an engineering type perspective**, so there's **much less biologically relevant contextualization**" – Trevor

"We could've been talking about the relevance to other classes, and that didn't happen... So that was a little disappointing" – Maddie

IPLS

" the professor went to **great lengths to connect the physics topics** that we were talking to biological phenomenon that we would be able to understand" – Trevor

"the attitude the Professor had..shaped how well his students participated and engaged with the material. I feel that the **class environment was structured** as such, **no student really felt uncomfortable asking a question**" – Maddie

"**I don't think the other classes even put in effort or tried to integrate the biomedical applications** into their teachings" – Clara

Conclusions

Survey Data - after the 1st semester, IPLS students express more positive attitudes towards the relevance of physics and math to biology. These attitudes grow even more positive during 2nd IPLS semester, and persist 1 year later

Interviews - evidence helps us understand the source of attitudes expressed in survey data. Explanatory coherence, disciplinary identity, and pedagogy/course structures emerged as factors influencing the attitudes expressed by students

Acknowledgements


Aqil MacMood


Nathaniel Peters


Catherine Crouch


Benjamin Geller


Chandra Turpen


Sarah Hiebert Burch

Special thanks to our advisory board Eric Brewe, Todd Cooke, Brad Davidson, Eric Kuo, and Sanjay Rebello

Come to our poster session Wednesday evening at PERC to learn more!!!

1710875