Characterizing "Physics Affinity" in Introductory Physics for Life Sciences at Three Institutions

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Prior Longitudinal Findings

Student attitudes about the **relevance of physics** to the life sciences, as well as certain **physical and quantitative skills**, have been shown to **improve during the Introductory Physics for Life Sciences (IPLS) sequence at Swarthmore**, and these **gains persist for at least a year or more (1).**

Research Question

How do students' Physics Affinity scores develop in response to three different instructional environments?

Physics Affinity Survey

Our physics affinity metric combines three dimensions that have been shown to affect learning and motivation. Items measuring interest (8), self-efficacy (8) and relevance (4) drawn from validated instruments (2).

Interest	Self-efficacy	Relevance for Life Sciences
Ex. "When I'm working on something in physics that I think is interesting, I continue working even when it takes a lot of time."	Ex. "I do not worry about my ability to solve physics problems."	Ex. "Physics is relevant for understanding biological processes."

Physics Affinity

Instructional Environments

We partnered with 2 large public institutions: "Yellow U" and "Blue U."

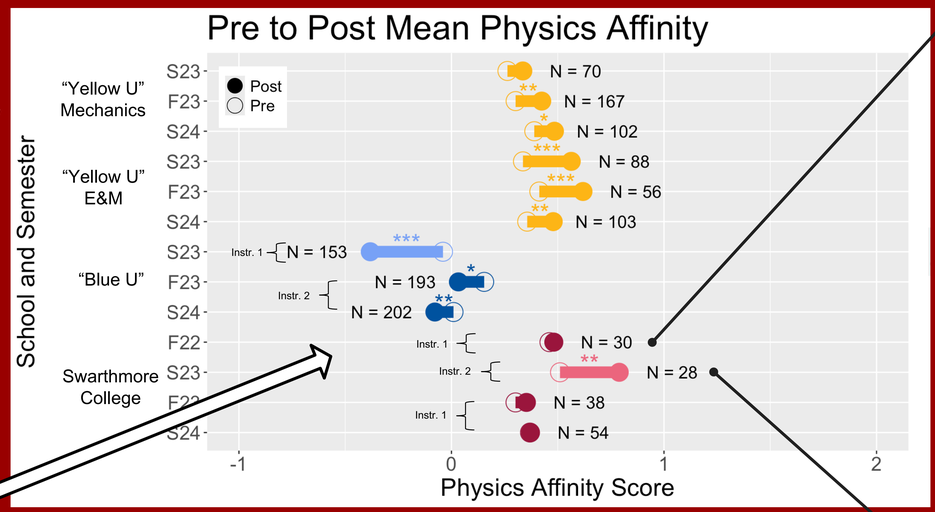
"Yellow U"	"Blue U"	Swarthmore College
• Very experienced instructor • Few LS connections • Carefully crafted learning progression	• Less experienced instructors • Instructor 2 included many more LS connections	• Both instructors used same curriculum • Instr. 1 prioritized comfortable learning environment • Instr. 2 emphasized LS connections more, gave more challenging assessments

Survey Analysis

- Matched data across each semester
- Converted 5-point Strongly Disagree to Agree responses to a -2 to +2 scale

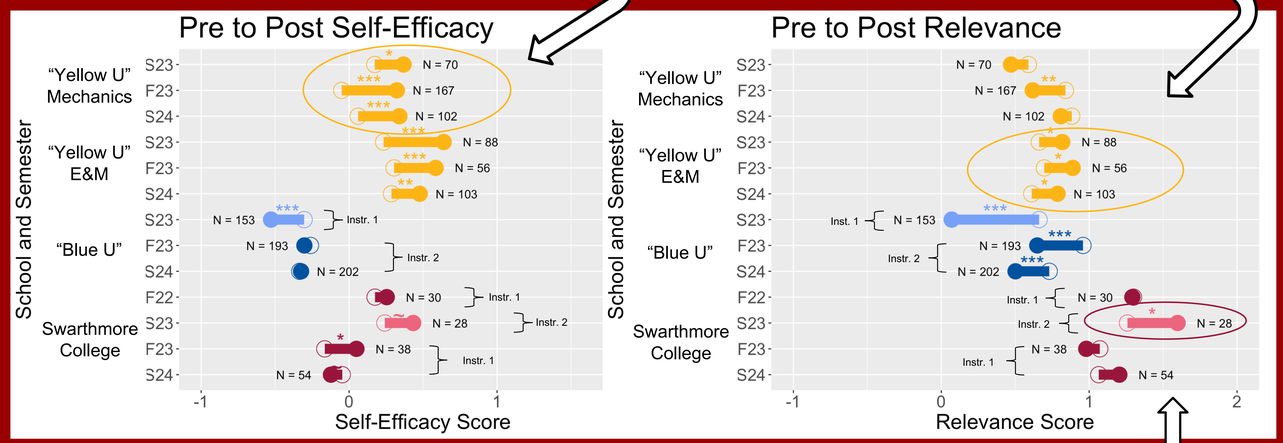
In different introductory physics courses for non-majors, students showed different initial physics affinity scores and different changes in affinity scores

"Blue U" students began with significantly lower affinity, which decreased over the course of the semester, but instruction <u>emphasizing LS connections significantly mitigated those losses</u>.



In a course with very few LS connections, "Yellow U" Mechanics students achieved notable gains in <u>self-efficacy</u> without corresponding gains in interest or relevance.

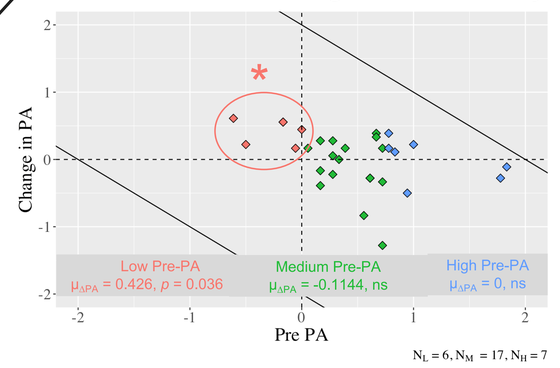
"Yellow U" E&M students achieved <u>modest relevance gains</u>, possibly due to an optics unit on human vision.



At Swarthmore, instructor 2 provided more <u>messaging</u> around LS connections and gave more <u>challenging assessments</u>. Students in that course displayed significant <u>affinity and relevance gains</u>.

Analysis by Incoming Affinity Scores

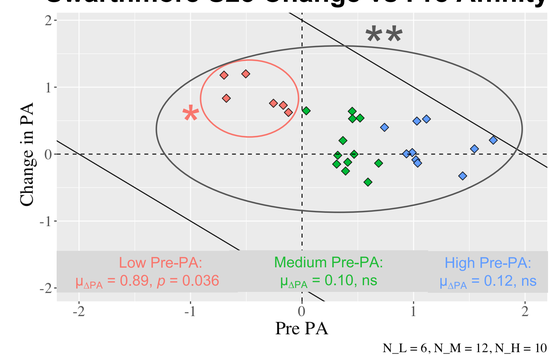
Swarthmore F22 Change vs Pre Affinity



Instructor 1 (F22, above): Even when the class average does not increase, initially low affinity students frequently show a significant increase.

Instructor 2 (S23, below): Physics affinity scores increase significantly overall; initially low affinity students increase the most, but even initially high affinity students show modest gains.

Swarthmore S23 Change vs Pre Affinity



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(1) Geller & Tipton *et al.*, PR-PER (2022), Geller & Rubien *et al.*, PR-PER (2022), Rak *et al.*, AAPT Talk (2020).
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Acknowledgements

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