Correlating students' views about experimental physics with their sense of project ownership

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Abstract

Multiweek projects in physics labs can engage students in authentic experimentation practices, and it is important to understand student experiences during projects along multiple dimensions. To this end, we conducted an exploratory quantitative investigation to look for connections between students' pre-project views about experimental physics and their post-project sense of project ownership. We administered the Colorado Learning Attitudes About Science Survey for Experimental Physics (E-CLASS) [1] and the Project Ownership Survey (POS) [2] to 96 students enrolled in 6 lab courses at 5 universities. E-CLASS and POS scores were positively correlated, suggesting that students' views about experimentation may be linked to their ownership of projects. This finding motivates future studies that could explore whether these constructs are causally related.

Views about experimentation

Definition
Ideas about which skills, practices, or goals are important for conducting experiments, and beliefs about whether experimentation is something that they can do or that they enjoy.

Instrument
E-CLASS [1]
30 Likert items, ranging from strongly disagree to strongly agree

Sample survey items
"Designing and building things is an important part of doing physics experiments."
"Communicating scientific results to peers is a valuable part of doing physics experiments"

Sense of project ownership

Definition
Right and responsibility to make one's own decisions about the project, investment in the success of the project, and feeling a personal connection to the project, which is "one's own."

Instrument
POS [2]
10 Likert items, ranging from strongly disagree to strongly agree

Sample survey items
"The findings of my research gave me a sense of personal achievement."
"I was responsible for the outcome of my research."

Course contexts

Courses in our study. *N* is the number of students for whom we have matched E-CLASS and POS scores. We collected data for two instances of Optics and one instance of all other courses.

Institution	Course	Project weeks	*N*
Selective, public, doctoral	Advanced Lab	5	8
Inclusive, public, master's	Advanced Lab	4	8
Inclusive, public, master's	Advanced Lab	4	13
Selective, private, bac.	Experimental Phys.	4	15
Selective, private, master's	Lasers Lab	7	19
	Optics Lab*	7	33
		Total	96

Methods

E-CLASS administered at start of course, POS at end.

96 students completed both surveys.

Item responses analyzed using a three-point scale that equates "(dis)agree" with "strongly (dis)agree."

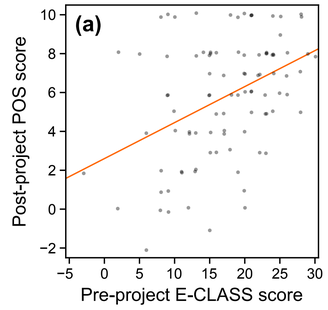
E-CLASS total score lies in range [−30, 30].

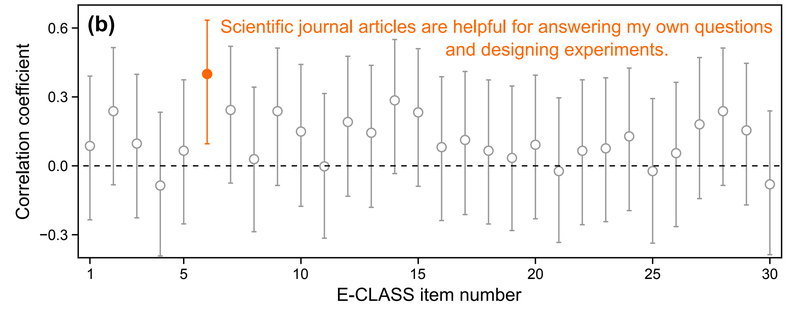
POS total score lies in range [−10, 10].

Computed Pearson correlation coefficient, *r*, for both
a) pre-project E-CLASS and post-project POS scores, and
b) individual E-CLASS items and POS scores.

Confidence intervals and *p*-values computed using standard Fisher transformation and t-test, using Bonferroni correction to account for multiple tests [3].

Students' E-CLASS and POS scores are positively correlated





(a) Scatter plot of matched POS and E-CLASS scores. To improve visibility of overlapping markers, a small artificial jitter has been added to each data point, and overlapping markers are darker than nonoverlapping ones. The curve is a line of best fit representing the positive correlation between POS and E-CLASS scores ($r = 0.41$, $p < 0.001$). **(b)** Correlations between POS score and each individual E-CLASS item score. Circular markers represent correlation coefficients. Error bars correspond to 95% confidence intervals, corrected for multiple comparisons. Only item 6 yielded a statistically significant correlation ($r = 0.40$, $p < 0.001$), indicated by a filled marker.

Plausible explanations

Causal
Students' sense of personal achievement on a project may be coupled to their view of experimentation as a process that they can meaningfully participate in and learn from (cf. Refs. [4,5]).

Causal
The belief that experimentation involves encountering difficulties may positively impact students' ability to cope with frustration and troubleshoot problems on their own (cf. Ref. [6,7]).

Non-causal
Previous project experience could simultaneously shift students' beliefs about what experimentation entails and increase their interest in articulating and exploring their own research questions.

References

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This material is based upon work supported by NSF under Grant Nos. DUE-1726045 and PHY-1734006.