Longitudinal Physics Attitude (CLASS) Data

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CLASS: Colorado Learning Attitudes about Science Survey

- The survey has been used extensively to examine student attitude changes pre and post within courses.
- It can also be used to track students attitudes from year to year.
- We have tracked the attitudes of several years of students in Physics as well as Engineering Physics.

CLASS: Colorado Learning Attitudes about Science Survey (W.K. Adams et al.)

- CLASS has 42 multiple choice questions
- Student answers are compared to expert answers
- The overall category uses 36 of the questions. There are 8 sub-categories with overlapping of some questions which utilize 27 of the questions.
- Examples of the questions in two of the categories, Problem Solving Confidence and Personal Interest, are listed in below

CLASS Questions in the category Problem Solving Confidence

- 15. If I get stuck on a physics problem on my first try, I usually try to figure out a different way that works.
- 16. Nearly everyone is capable of understanding physics if they work at it.
- 34. I can usually figure out a way to solve physics problems.
- 40. If I get stuck on a physics problem, there is no chance I'll figure it out on my own.

Personal Interest Category Questions

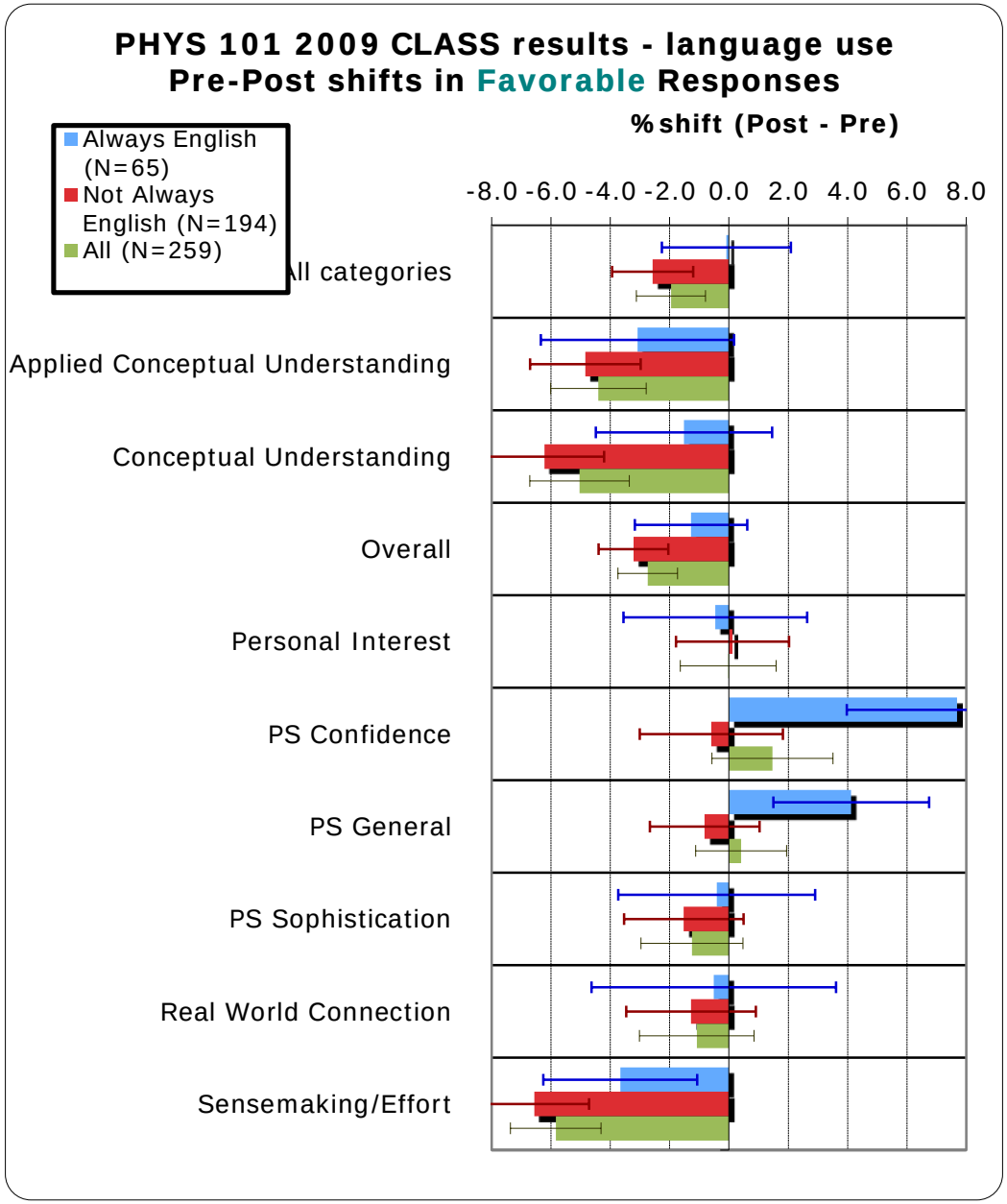
3. I think about the physics I experience in everyday life.
11. I am not satisfied until I understand why something works the way it does.
14. I study physics to learn knowledge that will be useful in my life outside of school.
25. I enjoy solving physics problems.
28. Learning physics changes my ideas about how the world works.
30. Reasoning skills used to understand physics can be helpful to me in my everyday life.

Use of the survey within courses

- Introductory science courses normally show a negative shift in student attitudes during a course unless particular attention is paid to student scientific beliefs (Elby, Redish & Hammer) .
- Attitudes of different cohorts within courses can also be examined. e.g. gender (Kost-Smith et al), language use, etc.

Effect of Students' Language on Learning Attitudes

- There is often concern that students working in a second language may experience courses differently.
- The small data sample from PHYS 101 shown in the next figure indicated no significant difference in language dependent shifts in any category except perhaps problem solving.
- There was no significant difference in the prescores in any category.


PHYS 101 2009 CLASS results - language use
Pre-Post shifts in Favorable Responses
Always English (N=65)
Not Always English (N=194)
All (N=259)
% shift (Post - Pre)
-8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0
All categories
Applied Conceptual Understanding
Conceptual Understanding
Overall
Personal Interest
PS Confidence
PS General
PS Sophistication
Real World Connection
Sensemaking/Effort

Tracking students 1st to 2nd year

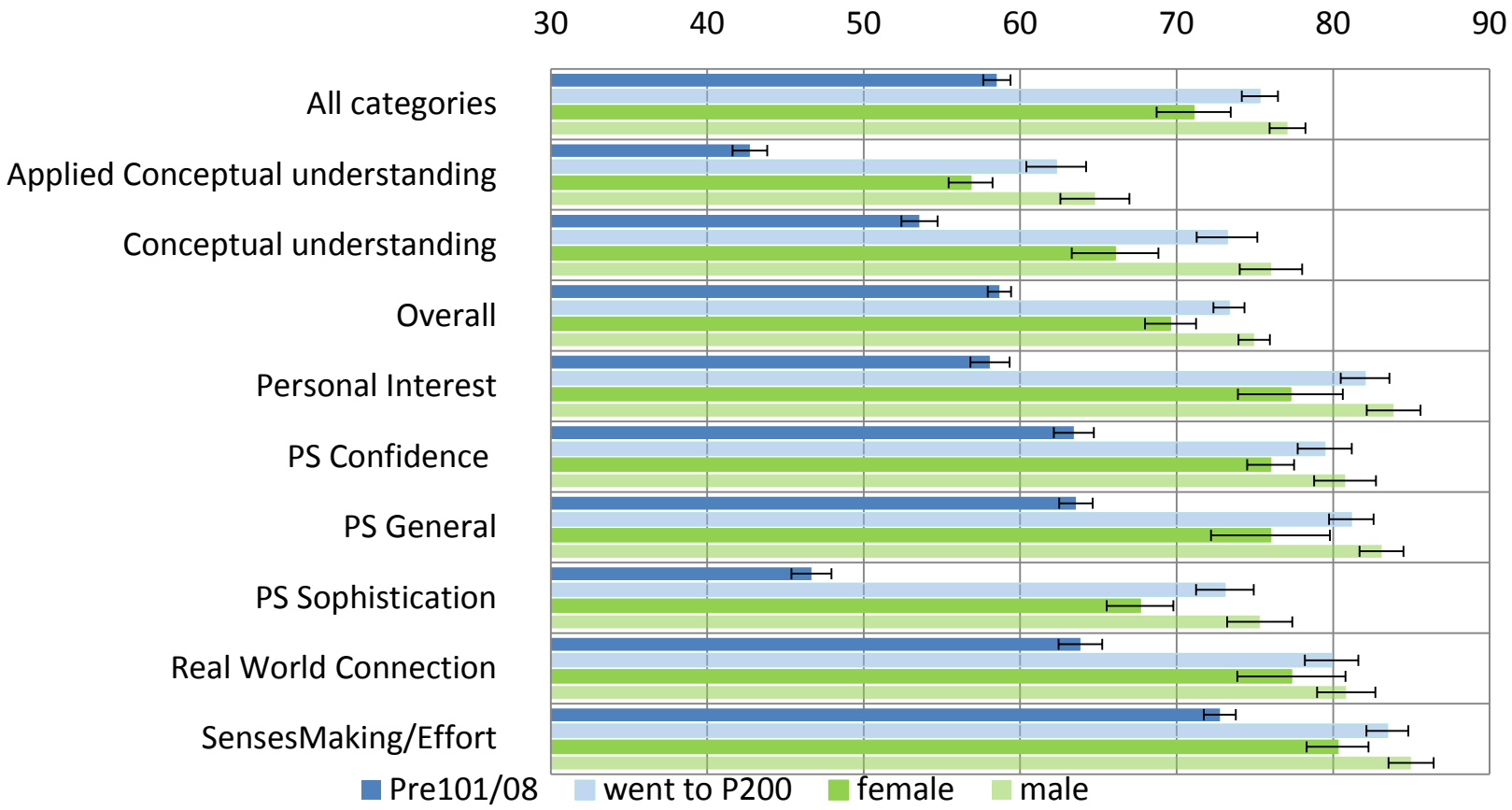
- The next graph compares the attitudes of students at the beginning of 1st year who eventually go to PHYS 200 with the attitudes of students in the large typical first year course PHYS 101.

- The results show much more positive attitudes for students who proceed to 2nd year physics in agreement with results reported at Colorado (Perkins & Gratny).

- The data in the table following that compares the attitudes of those proceeding students at the beginning of 1st yr and the beginning of 2nd year. There is little change indicating their beliefs are quite stable in agreement with the data of Slaughter et al.

- After that is a table showing similar results for ENG PHYS students.

CLASS Results Pre-Instruction Favorable Responses
pre first yr comparison between students who went to PHYS 200 and broad based course result PHYS 101 08W Term1 - pre P200(N=176,yrs=10W,12W,13W), female(N=52)



Attitudes of students proceeding to 2nd yr PHYS 200 at the beginning of 1st yr vs the beginning of 2nd yr

PHYS 200 students 10W,12W,13W				
Categories	ALL	Number:	175	(Diff of Avgs)
	Status	pre 1st yr	pre 2nd yr	SHIFT
Overall	fav	73.3	74.6	1.3
All categories	fav	75.3	76.4	1.1
Personal Interest	fav	82.0	84.9	2.9
Real World Connection	fav	79.9	83.2	3.3
PS General	fav	81.2	82.8	1.6
PS Confidence	fav	79.5	77.0	-2.4
PS Sophistication	fav	73.1	71.7	-1.4
SensesMaking/Effort	fav	83.5	80.8	-2.6
Conceptual understanding	fav	73.2	74.4	1.2
Applied Conceptual understanding	fav	62.3	62.9	0.6

Attitudes of ENG PHYS at the beginning of 1st yr vs the beginning of PHYS 250 (May of 2nd yr)

ENG PHYS PHYS 250 10S,11S,12S,13S						
Categories	**ALL**	Number: 138			**LARGE**	**Shift**
		pre 1st yr	**pre P250**	**SHIFT**	**SHIFT**	**StdErr**
Overall	fav	75.0	75.1	0.2		1.0
All categories	fav	77.0	76.3	-0.7		1.1
Personal Interest	fav	82.1	84.9	2.8		1.7
Real World Connection	fav	79.1	82.9	3.8		2.0
Problem Solving General	fav	82.1	80.3	-1.9		1.6
Problem Solving Confidence	fav	80.4	74.8	-5.6	-5.6	2.2
Problem Solving Sophistication	fav	76.1	68.8	-7.3	-7.3	2.2
SensesMaking/Effort	fav	82.8	81.2	-1.6		1.7
Conceptual understanding	fav	76.0	71.9	-4.1		2.1
Applied Conceptual understanding	fav	68.5	63.1	-5.4	-5.4	2.1

Tracking students 1st year to upper years

- We have surveyed upper year students in April 2013 and 2014 and matched to 1st year data for 84 students.
- The next table shows a slight decline in attitudes in the personal interest and problem solving categories.
- The subsequent table suggests that the slight declines are among the male and not the female students

Comparison of attitudes at the beginning of 1st year vs post upper year

Categories	ALL	Number:	84		LARGE	Shift
	Status	PRE 1st yr	Upper yr POST	SHIFT	SHIFT	SEM
All categories	fav	77.8	73.2	-4.5	-4.5	1.9
Applied Conceptual understanding	fav	66.3	63.4	-2.9		3.3
Conceptual understanding	fav	74.2	72.3	-1.9		2.7
Overall	fav	75.0	73.0	-2.0		1.7
Personal Interest	fav	84.6	78.6	-6.1	-6.1	2.8
PS Confidence	fav	80.7	71.4	-9.2	-9.2	3.0
PS General	fav	82.5	76.1	-6.4	-6.4	2.3
PS Sophistication	fav	75.8	64.6	-11.2	-11.2	2.9
Real World Connection	fav	83.9	79.2	-4.8		2.9
SensesMaking/Effort	fav	83.8	78.9	-5.0	-5.0	2.4

Shifts in attitudes pre 1st year to upper year by gender

pre 1st yr to upper yr shifts

Categories - favorable	WOMEN	Number: LARGE SHIFT	= 16 Shift SEM	MEN	Number: LARGE SHIFT	= 68 Shift SEM
All categories	-1.6		3.7	-5.2	-5.2	2.2
Applied Conceptual understanding	-1.6		5.6	-3.3		3.8
Conceptual understanding	-2.9		4.8	-1.7		3.1
Overall	1.3		2.9	-2.7		2.0
Personal Interest	-1.0		5.8	-7.3	-7.3	3.1
PS Confidence	0.0		6.6	-11.4	-11.4	3.3
PS General	-0.8		4.7	-7.7	-7.7	2.6
PS Sophistication	-5.2		4.8	-12.6	-12.6	3.4
Real World Connection	-7.8		4.3	-4.0		3.5
SensesMaking/Effort	1.8		5.0	-6.6	-6.6	2.7

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References

- W.K. Adams, K.K.Perkins, N.S.Podovesky, M.Dubson , N.D.Finkelstein and C.E.Wieman., ”New Instrument for measuring student beliefs about physics and learning physics: The Colorado Learning Attitudes about Science Survey”, Phys. Rev. ST Phys. Educ. Res. **2**, 010101(2006).
- A.Elby, “Helping physics students learn how to learn”, Am. J. Phys Suppl **69(7)**, S54(2001
- L.E. Kost-Smith , S.J.Pollock and N.D.Finkelstein, “Gender disparities in second semester college physics: The incremental effects of a ‘smog of bias’ “, Phys. Rev. ST Phys. Educ. Res. **6**, 020112(2010).
- K.K.Perkins & M. Gratny, “Who becomes a physics major”, PERC 2010 p256
- K.A. Slaughter, S.P. Bates & R.K. Galloway, “A longitudinal study of the development of attitudes and beliefs towards physics” PERC 2011 ,AIP Conf. Proc **1413**, 359(2012)