

Gender Differences in both Force Concept Inventory and Introductory Physics Performance

Jennifer Docktor, Kenneth Heller, + UM PER Group

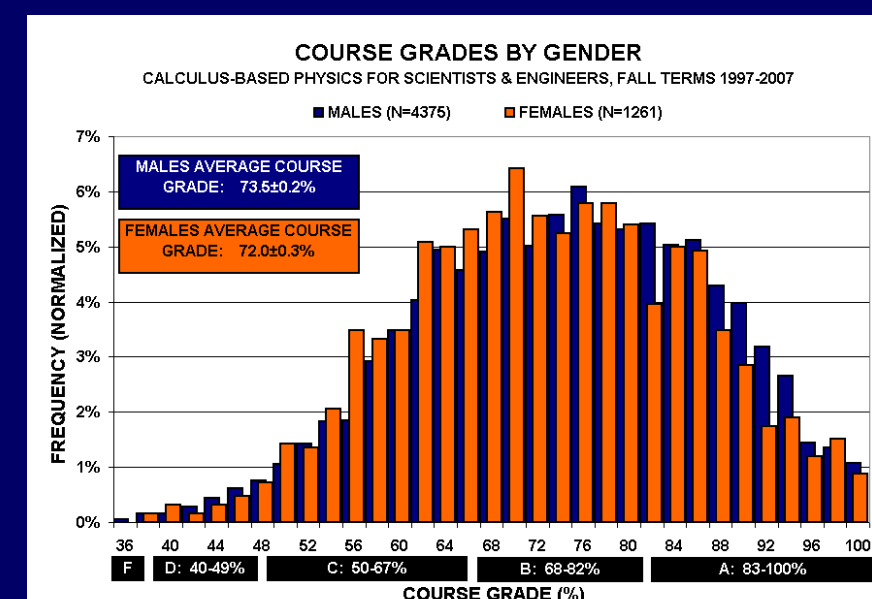
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STUDENT BACKGROUND FACTORS

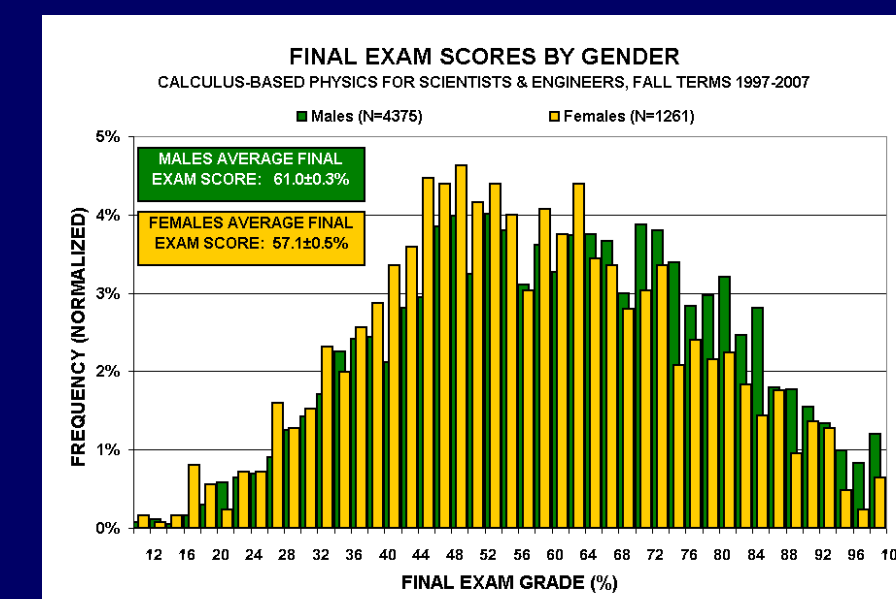
RESPONDENTS (%)		COURSE GRADE (%)		FCI PRE-TEST SCORE (%)	
FEMALES	MALES	FEMALES	MALES	FEMALES	MALES
31/32 What is your intended major?					
14%	4%	74.6 ± 0.9	74.7 ± 1.0	35.4 ± 1.3	47.8 ± 1.4
9%	3%	71.3 ± 1.2	73.4 ± 1.1	32.3 ± 1.3	53.2 ± 1.9
6%	13%	66.1 ± 1.3	70.2 ± 0.6	34.4 ± 1.7	51.2 ± 0.8
45%	64%	71.6 ± 0.5	73.7 ± 0.2	38.3 ± 0.7	52.8 ± 0.4
4%	2%	69.1 ± 1.6	77.1 ± 1.2	40.6 ± 2.4	55.3 ± 2.1
4%	5%	70.6 ± 1.6	75.6 ± 0.8	48.1 ± 2.6	61.7 ± 1.4
3%	3%	73.1 ± 2.0	69.7 ± 1.0	35.9 ± 2.4	50.7 ± 1.6
11%	9%	71.2 ± 1.1	73.0 ± 0.6	37.0 ± 1.3	50.6 ± 1.0
8%	8%	76.6 ± 1.2	75.4 ± 0.7	40.9 ± 1.7	55.6 ± 1.1
33 How well prepared do you feel to deal with the subject matter of physics?					
3%	3%	71.0 ± 0.9	74.3 ± 1.4	32.6 ± 2.3	58.5 ± 2.4
13%	7%	69.3 ± 1.0	69.9 ± 0.8	30.0 ± 1.0	42.0 ± 1.0
51%	39%	71.2 ± 0.5	71.3 ± 0.3	35.5 ± 0.6	47.2 ± 0.4
27%	40%	74.3 ± 0.7	74.7 ± 0.3	42.6 ± 1.0	55.9 ± 0.5
5%	11%	78.5 ± 1.9	80.1 ± 0.5	56.5 ± 2.8	68.1 ± 0.9
34 Have you taken a physics course before?					
16%	10%	71.0 ± 0.9	72.1 ± 0.7	27.5 ± 0.8	40.5 ± 0.9
57%	61%	72.2 ± 0.5	72.9 ± 0.3	38.7 ± 0.6	52.7 ± 0.4
19%	22%	74.6 ± 0.9	75.9 ± 0.4	43.7 ± 1.2	60.9 ± 0.7
4%	3%	71.5 ± 1.7	70.3 ± 1.3	39.3 ± 2.4	53.8 ± 1.9
4%	5%	68.7 ± 2.1	72.4 ± 1.1	44.8 ± 3.3	54.9 ± 1.5
35 Are you repeating this course?					
97%	96%	72.4 ± 0.4	73.7 ± 0.2	37.7 ± 0.5	53.1 ± 0.3
2%	2%	65.1 ± 3.1	66.7 ± 1.5	40.9 ± 3.8	50.5 ± 2.2
1%	2%	68.7 ± 2.9	74.2 ± 1.6	41.2 ± 5.2	56.7 ± 2.3
36 What was the last high school math class you completed?					
2%	2%	75.4 ± 2.3	68.7 ± 1.5	36.4 ± 4.1	47.2 ± 2.1
6%	4%	69.7 ± 1.4	70.5 ± 1.0	29.2 ± 1.4	45.5 ± 1.4
22%	22%	68.3 ± 0.7	71.4 ± 0.4	35.1 ± 1.0	49.3 ± 0.6
65%	66%	73.4 ± 0.4	74.2 ± 0.2	39.2 ± 0.6	54.3 ± 0.4
5%	7%	74.6 ± 1.8	78.0 ± 0.7	40.8 ± 2.3	58.4 ± 1.2
37 What was the last college math class you completed prior to taking this course?					
39%	56%	72.8 ± 0.6	74.2 ± 0.3	42.0 ± 0.8	55.6 ± 0.4
1%	1%	66.8 ± 2.7	68.9 ± 2.1	36.9 ± 3.8	44.7 ± 2.9
5%	5%	62.9 ± 1.4	66.5 ± 0.9	33.6 ± 2.0	44.2 ± 1.2
44%	30%	71.8 ± 0.5	72.8 ± 0.4	34.8 ± 0.7	49.7 ± 0.6
11%	7%	76.1 ± 1.1	77.6 ± 0.7	36.8 ± 1.5	53.6 ± 1.2
38 When did you take your most recently completed math course?					
52%	48%	72.0 ± 0.5	73.4 ± 0.3	37.7 ± 0.6	52.6 ± 0.4
13%	11%	72.2 ± 1.0	73.0 ± 0.6	35.2 ± 1.1	50.4 ± 1.0
25%	35%	73.2 ± 0.7	73.7 ± 0.3	39.2 ± 1.0	53.8 ± 0.5
9%	6%	71.1 ± 1.2	74.2 ± 0.8	37.1 ± 1.7	56.0 ± 1.4
2%	1%	71.5 ± 2.4	79.0 ± 2.6	38.9 ± 4.0	57.9 ± 3.6
39 Are you enrolled in a math course this semester?					
24%	9%	75.0 ± 0.7	75.5 ± 0.7	35.8 ± 1.0	52.1 ± 1.0
76%	91%	71.3 ± 0.4	73.4 ± 0.2	38.5 ± 0.5	53.1 ± 0.3
40 How many science classes, other than this course, have you taken in college?					
30%	48%	71.8 ± 0.6	74.0 ± 0.3	40.6 ± 0.9	55.0 ± 0.4
18%	20%	73.5 ± 0.9	75.2 ± 0.4	43.4 ± 1.2	56.7 ± 0.7
17%	15%	71.1 ± 0.8	71.9 ± 0.5	35.0 ± 1.1	48.3 ± 0.7
18%	10%	71.7 ± 0.8	70.9 ± 0.6	34.2 ± 1.0	46.7 ± 0.9
17%	6%	73.3 ± 0.9	73.9 ± 0.8	34.0 ± 1.1	47.4 ± 1.1
41 How computer literate do you consider yourself?					
3%	2%	70.0 ± 2.3	73.3 ± 1.6	36.2 ± 2.2	48.2 ± 2.7
17%	9%	73.4 ± 0.9	73.2 ± 0.7	38.2 ± 1.3	50.7 ± 1.1
57%	40%	72.0 ± 0.5	73.7 ± 0.3	37.6 ± 0.6	51.6 ± 0.5
22%	34%	71.4 ± 0.8	73.6 ± 0.3	39.8 ± 1.1	54.3 ± 0.5
2%	15%	71.5 ± 2.0	73.4 ± 0.5	33.9 ± 3.7	57.8 ± 0.8
42 What is your approximate college GPA on a 4.0 system?					
43%	61%	72.7 ± 0.5	74.4 ± 0.2	41.1 ± 0.7	55.5 ± 0.4
33%	19%	76.9 ± 0.6	77.9 ± 0.4	38.0 ± 0.8	52.4 ± 0.7
18%	14%	65.8 ± 0.6	68.7 ± 0.5	31.3 ± 0.9	46.9 ± 0.8
5%	6%	60.4 ± 1.3	63.5 ± 0.8	30.8 ± 1.8	43.8 ± 1.2
43 What grade do you expect to receive in this course?					
54%	60%	74.5 ± 0.5	75.9 ± 0.2	39.2 ± 0.7	55.2 ± 0.4
42%	37%	69.8 ± 0.5	70.4 ± 0.3	36.4 ± 0.7	50.3 ± 0.5
3%	3%	66.5 ± 2.1	66.0 ± 1.2	31.3 ± 1.8	44.2 ± 1.6
44 Approximately how much time per week do you anticipate spending on this course in addition to regular class sessions?					
0%	1%	60.8 ± 4.0	77.6 ± 1.8	33.3 ± 3.6	62.2 ± 3.3
18%	26%	71.5 ± 0.8	73.8 ± 0.4	37.8 ± 1.2	56.3 ± 0.6
53%	53%	72.1 ± 0.5	73.8 ± 0.3	37.9 ± 0.6	52.9 ± 0.4
24%	17%	72.7 ± 0.7	73.0 ± 0.5	37.4 ± 0.9	49.6 ± 0.7
5%	3%	74.3 ± 1.8	71.5 ± 1.1	37.0 ± 2.0	45.6 ± 1.5
45 How many total course credits are you taking this semester?					
1%	1%	75.9 ± 2.7	76.4 ± 2.3	38.2 ± 3.9	51.7 ± 4.1
1%	1%	71.8 ± 3.9	71.7 ± 2.1	35.2 ± 5.2	52.6 ± 2.9
9%	9%	70.3 ± 1.2	70.6 ± 0.7	34.4 ± 1.4	47.2 ± 1.0
69%	74%	72.1 ± 0.4	73.4 ± 0.2	37.4 ± 0.6	53.6 ± 0.4
21%	14%	73.5 ± 0.8	76.4 ± 0.5	40.1 ± 1.1	54.0 ± 0.8
46 How many hours per week are you employed?					
47%	56%	73.9 ± 0.5	75.2 ± 0.3	40.9 ± 0.7	54.6 ± 0.4
24%	21%	73.1 ± 0.7	73.1 ± 0.4	37.9 ± 1.0	52.9 ± 0.7
22%	18%	69.4 ± 0.7	70.4 ± 0.5	33.2 ± 0.9	49.5 ± 0.7
6%	4%	66.7 ± 1.3	69.8 ± 0.9	29.4 ± 1.1	48.4 ± 1.4
2%	1%	68.3 ± 2.4	69.3 ± 1.7	33.0 ± 2.8	46.3 ± 2.7
47 What is your age?					
5%	4%	79.0 ± 1.5	77.5 ± 1.0	42.3 ± 2.3	52.2 ± 1.6
69%	80%	72.2 ± 0.4	73.9 ± 0.2	38.8 ± 0.6	54.3 ± 0.3
17%	10%	71.8 ± 0.8	70.2 ± 0.6	33.3 ± 1.0	47.1 ± 0.9
4%	2%	66.7 ± 2.0	72.0 ± 1.3	34.6 ± 2.9	45.5 ± 2.0
4%	4%	71.9 ± 1.6	72.3 ± 1.1	35.6 ± 2.1	47.2 ± 1.5
48 What type of residence do you live in (choose only one)?					
51%	62%	73.0 ± 0.5	74.3 ± 0.3	41.6 ± 0.7	55.8 ± 0.4
16%	11%	71.8 ± 0.9	71.6 ± 0.6	35.5 ± 1.1	48.8 ± 0.9
13%	10%	69.4 ± 1.0	71.6 ± 0.7	31.6 ± 1.2	46.4 ± 1.0
18%	16%	71.7 ± 0.9	73.5 ± 0.5	35.4 ± 1.2	52.1 ± 1.0
1%	1%	67.3 ± 2.9	70.0 ± 1.9	33.8 ± 4.1	44.6 ± 2.8

GRADES BY GENDER



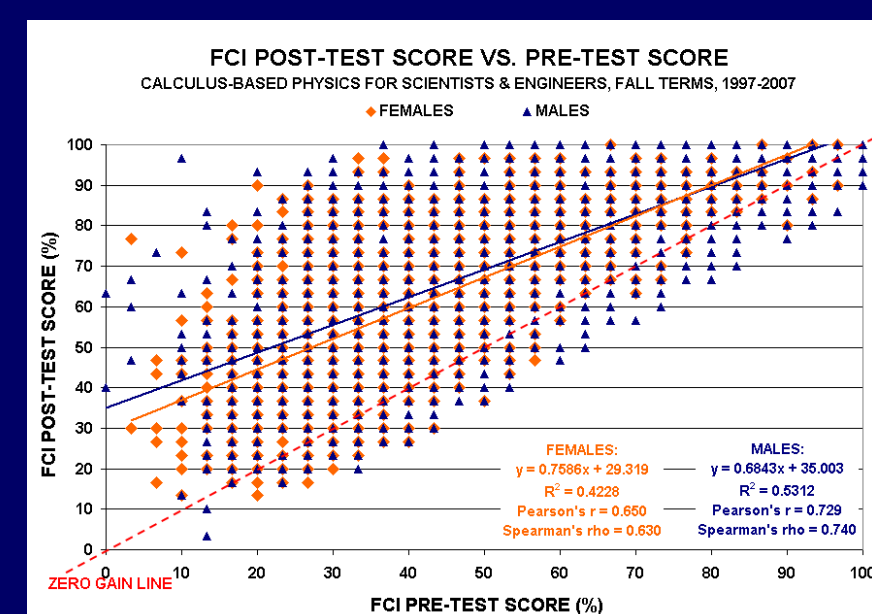
THE GENDER DIFFERENCE IS 1.5±0.2% (SIGNIFICANCE $p < 0.0001$ FROM NON-PARAMETRIC TEST)

FINAL EXAM BY GENDER

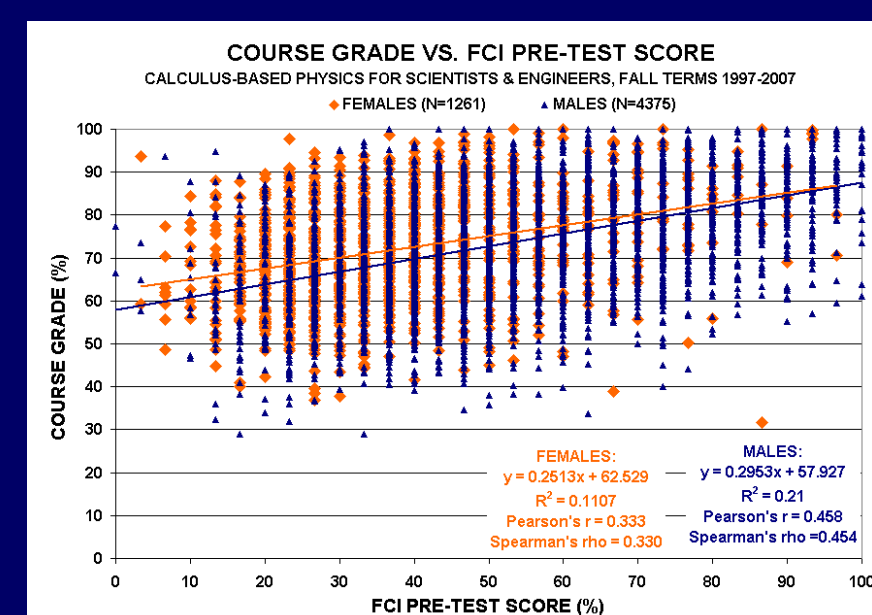


THE GENDER DIFFERENCE IS 3.9±0.6% (SIGNIFICANCE $p < 0.0001$ FROM NON-PARAMETRIC TEST)

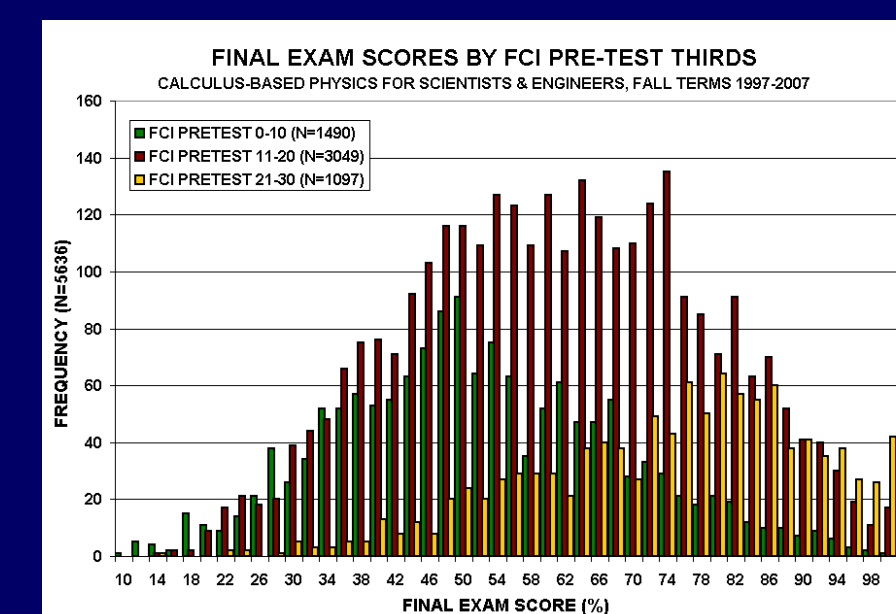
FCI POST VS. PRE



GRADE VS. FCI PRE-TEST

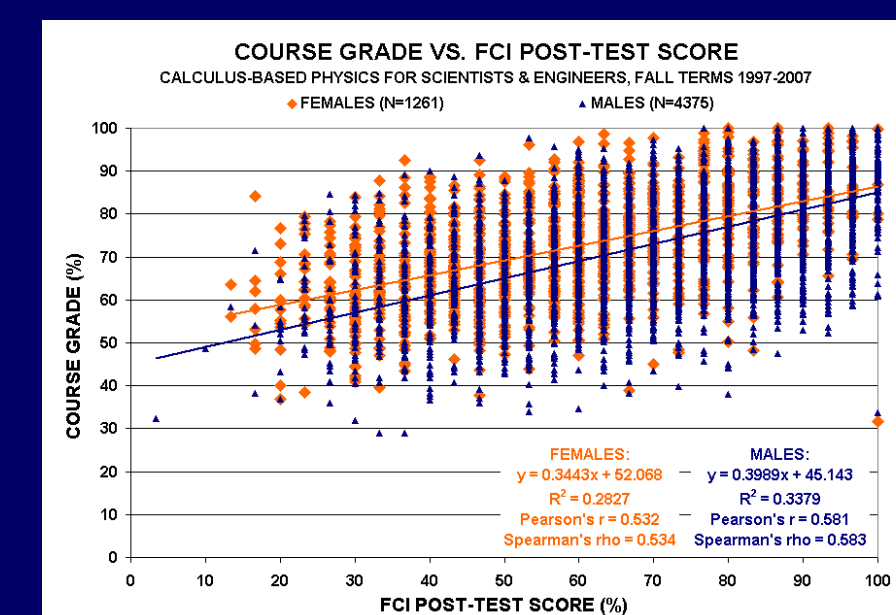


FINAL EXAM BY FCI PRE



(DISTRIBUTION IS SIMILAR FOR MALES & FEMALES)

GRADE VS. FCI POST-TEST



FINDINGS: COURSE PERFORMANCE

- There is a small but significant difference in course grades and final exam scores for males & females
 - Consistent with Tai & Sadler (2001): males perform one-sixth of a letter grade higher than females in university physics
- Students who took high school physics (N=4731) have a small but significantly better physics grade (73.5±0.2%) than those who did not (N=701) (71.5±0.5%); non-parametric test significant at $p < 0.0001$
 - Consistent with Sadler & Tai (2001)
- No significant difference in physics grade between females who took high school physics (N=998) with a grade of 72.4±0.4% and those who did not (N=219) with a grade of 71.1±0.8%; non-parametric test is NOT significant, $p = 0.131$
- A significant difference in physics grade between males who took high school physics (N=3733) with a college grade of 73.8±0.2% and those who did not (N=482) with a grade of 71.7±0.6%; non-parametric test significant at $p < 0.001$
- For females and males who took high school physics, the grade difference of 1.4±0.4% is significant ($p < 0.001$)
- For females and males who did not take high school physics, the grade of difference 0.6±1.0% is NOT significant ($p = 0.435$)
- Taking high school physics is weakly correlated with physics grade, and is significant for all students combined ($r = 0.054$, $\rho = 0.054$, $p < 0.0001$); This weak but statistically significant relationship agrees with Sadler & Tai (2001)
- Taking high school physics and physics grade is only significant for males (Females: $r = 0.041$, $p = 0.158$; $\rho = 0.043$, $p = 0.131$; Males: $r = 0.053$, $\rho = 0.051$, $p < 0.001$)
- Taking calculus in high school is correlated with physics grade, and is significant for all students combined ($r = 0.132$, $\rho = 0.130$, $p < 0.0001$); This weak but statistically significant relationship agrees with Sadler & Tai (2001)
- The relationship between taking high school calculus and physics grade is stronger for females than for males (Females: $r = 0.167$, $\rho = 0.172$, $p < 0.0001$; Males: $r = 0.122$, $\rho = 0.117$, $p < 0.0001$)
- The relationship between taking high school calculus and physics grade is stronger than taking high school physics and grade. This is consistent with other research findings [2, 3]

REFERENCES

- [1] R.H. Tai and P.M. Sadler, "Gender differences in introductory undergraduate physics performance: university physics versus college physics in the USA," Int. J. Sci. Educ. 23(10), 1017-1037 (2001).
- [2] P.M. Sadler and R.H. Tai, "Success in introductory college physics: The role of high school preparation," Sci. Ed. 85(2), 111-136 (2001).
- [3] Z. Hazari, R.H. Tai, and P.M. Sadler, "Gender differences in introductory university physics performance: The influence of high school physics preparation and affective factors," Sci. Ed. 91(6), 847-876 (2007).



Grant DUE- 0715615

docktor@physics.umn.edu, heller@physics.umn.edu