Gender Differences in Conceptual Physics Lab Technology

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Premise and Setup

In 2006, we received a grant of tablet PCs and related equipment from Hewlett Packard and set out to use them to revise several of our classes under the Wandering Interactive Lecture Demonstrations (WILD) program (see details to the left).

A survey given at the end of the Spring 2007 term suggested there might be some minor gender effects due to the use of technology, so additional surveys were given at the beginning and end of Spring 2008 after further revision of the course materials.

Both the pre-survey and post-survey were administered anonymously online in exchange for extra credit points (finishing the survey got students a code word to enter in an online assignment for the points). Each survey asked a number of questions on a Likert-like scale:

1 – Disagree   3 – Agree Somewhat
2 – Disagree Somewhat   4 – Agree

Additionally, students were asked their gender and their class standing (Freshman, Sophomore, etc). Course grades were not investigated, given the nature of the class as primarily collaborative.

Questions on the two surveys were similar, but deliberately not identical. There were also open response items, which will not be discussed in detail here.

Survey Items

Pre-Survey (second week of class):

A1: Before taking this course, I have used a computer similar to the tablet PCs used in lab.

A2: I have previous experience with OpenOffice.

A3: I am comfortable using a computer for my course work.

A4: I would rather work on my lab reports outside of class.

A5: I find this course intimidating

Post-Survey (second-to-last week of class):

B1: I felt I learned a reasonable amount in this class.

B2: I liked using the tablet computers to take data.

B3: I liked using the tablet computers to write my lab reports.

B4: I would have preferred that the tablet computers be used more than they were.

B5: I found the tablet computers easy to use for data collection.

B6: I found the tablet computers easy to use for writing my lab reports.

B7: I have used tablet computers like this before the start of this course.

B8: I would like to use a tablet computer like this one in other courses I am taking.

B9: I would rather have had more time to write my lab reports outside of class, rather than uploading the reports during class.

Pre-Post Matches

A1 to B7   A4 to B9

A3 to B2, B3, B4 (very loosely), B5 and B6

Chi-Squared Results of Interest

General comfort level with computer use (A3) did not necessarily translate to liking the computers in this class (B2 though B6). The extremely strong difference on B4 may simply be due to the fact that it would be difficult to use the computers more than they were already.

While there was no significant pre-survey gender difference in self-reported prior experience with the hardware, there was a marked gender difference in the post-survey. Female students were much more likely post-instruction to consider the tablet PCs unlike anything they had used before.

Male students were more likely to report previous experience with OpenOffice.

Male students, on average, were nearly a full class rank older the female students (Junior vs. Sophomore).

There was no significant difference in the self-reported evaluation of student learning, which averaged "Agree Somewhat" to the statement "I felt I learned a reasonable amount in this class."

Open Response Notes

Student opinions of the hardware were generally positive or neutral. A recurring problem with the stylus jamming in its slot caused some student complaints, and that has been fixed.

The software was a bit more problematic. Students reported numerous system freezes and problems with the network scanning, and several cited a dislike for OpenOffice, asking that we purchase a Microsoft Office license instead. However, there weren't enough comments in total to really tell if there was a gender effect there.

A few of the comments suggest that enforced group role-rotation might be a good idea for the course, as some groups fell into a pattern of one person always doing the typing and never participating in the experiments.

Additional time spent on training with the computers might alleviate some of the concerns expressed in the open comments, but probably isn't feasible. In fact, a couple of students complained that too much time was spent on learning to use the computers already, so we're likely near a balance point between too much training and too little.

Conclusions

Male students seem to come into the class with more background in computer technology (both hardware and software), despite the course being for those outside the SMET majors.

Despite some significant differences in background and preparation, student opinions of their own learning did <u>not</u> show a gender effect.

Physical World Lab – Phys103

Physical World Lab is a 1 credit-hour laboratory course offered at Kansas State University, and associated with Physical World 1 (Phys101). The course is "math light" and intended mainly for students in non-SMET majors who need to take a laboratory course.

The course covers mechanics, electricity and magnetism and optics, meeting 13 times for 2 hours each during the semester. It is assumed that students can perform basic algebra and trigonometry, but the main emphasis is on the conceptual aspects of the material.

Enrollment tends to be majority-female, as borne out by the data presented here. Teaching assistants, both graduate and undergraduate, are responsible for the course.

WILD
Wandering Interactive Laboratory Demonstrations

The WILD program makes use of a grant of tablet PCs from Hewlett-Packard to let students get away from their desks occasionally and take data in a variety of settings, using PASCO sensors and other equipment. All lab reports are written during class using OpenOffice and submitted electronically via the K-State Online course management system.

2007 Post-Survey Data

Post-Survey	B1	B2	B3	B4	B5	B6	B7	B8	B9	Class Standing	
Male Disagree	2	2	3	3	2	1	4	1	2	7	Freshman
Male Disagree Somewhat	2	1	2	7	1	2	1	3	2	7	Soph
Male Agree Somewhat	14	10	7	12	14	8	8	10	14	7	Junior
Male Agree	8	13	14	4	9	15	13	12	8	5	Senior
Male Average	3.08	3.31	3.23	2.65	3.15	3.42	3.15	3.27	2.12	2.38	
Male StDev	0.84	0.88	1.03	0.89	0.83	0.81	1.08	0.83	1.21	1.10	
Female Disagree	2	8	10	25	9	6	26	15	54	33	Freshman
Female Disagree Somewhat	16	9	8	21	13	8	10	13	11	21	Soph
Female Agree Somewhat	31	28	19	22	29	28	12	24	4	11	Junior
Female Agree	23	27	35	4	21	30	24	20	3	7	Senior
Female Average	3.04	3.03	3.10	2.07	2.86	3.14	2.47	2.68	3.04	1.89	
Female StDev	0.81	0.98	1.08	0.94	0.98	0.92	1.29	1.10	0.81	1.00	

Item	df	Chi-Squared: Men to Women	
B1	1	1.016	
B2	1	0.595	
B3	1	0.156	
B4	1	6.131	$p < 0.02$
B5	1	0.573	
B6	1	1.032	
B7	1	4.159	$p < 0.05$
B8	1	5.273	$p < 0.05$
B9	1	7.920	$p < 0.01$
All Nine	1	16.5	$p < 0.001$
Post-Standing	3	4.53	

2008 Raw Pre-Post Data

Pre-Survey	A1	A2	A3	A4	A5	Class Standing	
Male Disagree	9	20	1	22	16	8	Freshman
Male Disagree Somewhat	6	10	3	6	16	18	Soph
Male Agree Somewhat	15	8	15	12	9	10	Junior
Male Agree	14	6	25	4	3	7	Senior
Male Average	2.77	2.00	3.45	1.95	1.98	3.43	
Male StDev	1.12	1.10	0.73	1.08	0.93	1.04	
Female Disagree	19	51	2	41	19	39	Freshman
Female Disagree Somewhat	9	10	6	14	23	19	Soph
Female Agree Somewhat	22	5	23	12	21	8	Junior
Female Agree	20	4	39	3	7	4	Senior
Female Average	2.61	1.46	3.41	1.67	2.23	2.67	
Female StDev	1.17	0.86	0.77	0.91	0.97	0.90	

Post-Survey	B1	B2	B3	B4	B5	B6	B7	B8	B9	Class Standing	
Male Disagree	4	4	4	6	4	4	11	10	20	8	Freshman
Male Disagree Somewhat	4	9	9	19	8	3	9	6	5	16	Soph
Male Agree Somewhat	15	8	6	10	11	16	6	13	8	11	Junior
Male Agree	18	20	22	6	18	18	15	12	7	6	Senior
Male Average	3.15	3.07	3.12	2.39	3.05	3.17	2.61	2.66	2.05	3.37	
Male StDev	0.96	1.06	1.08	0.92	1.02	0.95	1.24	1.15	1.20	0.97	
Female Disagree	4	4	6	20	4	5	41	17	37	28	Freshman
Female Disagree Somewhat	10	14	9	25	11	8	10	19	10	21	Soph
Female Agree Somewhat	24	21	19	10	27	18	3	13	10	4	Junior
Female Agree	22	21	26	5	18	29	4	11	3	6	Senior
Female Average	3.07	2.98	3.08	2.00	2.98	3.18	1.48	2.30	1.65	2.80	
Female StDev	0.90	0.93	1.00	0.92	0.87	0.97	0.88	1.08	0.94	0.96	

2008 Pre-Post χ^2

Comparison	df	Men	Women	All
A1 to B7	1	0.051	18.4***	10.9***
A3 to B2	1	2.51	2.32	4.83*
A3 to B3	1	1.99	3.54	5.43*
A3 to B4	1	11.6***	39.4***	51.3***
A3 to B5	1	2.62	1.49	4.01*
A3 to B6	1	2.62	4.3*	6.78**
A4 to B9	1	0.89	0.015	0.76

$$*\ p < 0.05$$
$$**\ p < 0.01$$
$$***\ p < 0.001$$

All χ^2 analyses (both 2007 and 2008 data sets) used only "Agree" and "Disagree" responses, disregarding the "Agree Somewhat" and "Disagree Somewhat" responses.

2008 Male-Female χ^2

Item	df	Men to Women	
A1	1	0.54	
A2	1	4.1	$p < 0.05$
A3	1	0.04	
A4	1	1.33	
A5	1	0.79	
All Five	1	1.91	
Pre-Standing	3	17.7	$p < 0.001$
B1	1	0.067	
B2	1	0.004	
B3	1	0.11	
B4	1	3.49	$p < 0.1$
B5	1	0	
B6	1	0.12	
B7	1	20	$p < 0.001$
B8	1	1.15	
B9	1	4.31	$p < 0.05$
All Nine	1	13.5	$p < 0.001$
Post-Standing	3	12.2	$p < 0.01$