Gender and Science Education

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Is gender an issue in the science classroom?

What are the numbers of men and women in science classrooms?

- What are the numbers in your school?

Should these numbers be changed?

Science for All

- Need a scientifically literate public
- Need science and technology trained workers
- Need to be encouraging all interested individuals
- Are we doing that?

Men, women, and physical science

Small or no differences in course taking in science up to high school

- Biology: 92% of men, 95% of women
- Chemistry: 53% of men, 59% of women
- Physics: 27% of men, 22% of women

Introductory college course enrollments:

- Biology: 27% of men, 39% of women
- Chemistry: 38% of men, 30% of women
- Physics: 30% of men, 15% of women

Undergraduate physical science

Men receive 64.5% of bachelor's degrees in the physical sciences, women receive 35.5%.

In physics (the worst of the sciences) women receive only 19% of bachelor's degrees

58% of chemistry bachelors went to men; 42% went to women

Where are the women?

Obviously there is an under-representation of women in the physical sciences

What are possible causes?

Discussion

Why do you think there are so few women in science?

Why so few women?

Barriers:

- Peer culture
- Peer harassment
- Bad counseling and advice
- Sexism from administrators and teachers
- Classroom culture of sexism
- Lack of female teachers/role models (25%)
- Parental influence
- Poor science pedagogy

"In 1962 I switched to a new high school. I wanted to sign up for physics, but the principal would not allow it. His comment was that a girl had no need for physics."

Failing at Fairness, 1994, pg. 120

During the roll call on the first day of class, Mr. Y called out the name of a girl who was head varsity cheerleader, then stopped and said "What are you doing in chemistry? Shouldn't you be out jumping up and down or something?"

Leach, *Sch. Sci. & Math*, 1995

On the first day of class, students were told to sit where they wanted the next day. When Kim entered class the next day, and took a seat toward the middle of the room, Mr. Z approached her and asked her to please move to the front, because he "liked to look at her."

When Kim was working on an assignment in class one day, Mr. Z leaned over her desk and said, "I guess you won't kiss me because you think I look like the elephant man." Dumbfounded, she remained silent but replied by pointing to his wedding ring.

Leach, *Sch. Sci. & Math*, 1995

Jennifer noticed that Mr. X focused his attention on the seven male students who sat in front of her and to her left. She raised her hand to answer questions; he ignored her. She raised her hand to ask questions; he ignored her. At one point, [the other female students] began tallying her attempts to respond in class. During a five day class period, she raised her hand to answer or ask a question 32 times. She was never once acknowledged.

Leach, *Sch. Sci. & Math*, 1995

Discussion

How many female science teachers are in your school, your district?

Are you aware of incidents of harassment in your school?

- Teacher-student
- Student-student

High school science lab

- Lab and hands-on experiences are some of the most effective teaching techniques in science; but only if students participate
- In mixed-sex classes and groups, male students tend to dominate equipment and materials; female students are often relegated to role of note-taker and recorder

Discussion

Do you see gender disparities in your classroom?

What are some of the differences between the boys and girls in your classes?

Gender as Context

Context can have a powerful effect on learning; how does gender serve as part of the context of learning?

- inquiry lab example

Gender as context goes beyond one's biological sex, to include the cultural and social issues surrounding it

Gender Differences in Science

- Interest in science
- Course-taking patterns
- Major course of study
- Career choices
- Achievement
- Attitudes

Biological/Psychological Differences

Meta-analyses suggest no large or significant differences in cognitive *ability* between males and female; though there is an increasing amount of research on cognitive *processes*.

Cultural training: Memory tasks (lists, instructions)

Learning Styles

Learning styles probably differ by gender, but research results vary widely: men are more abstract learners, women have more anxiety about study success; men are more intuitive, women are more analytical; women more organized, men more undirected, etc.

Different tests demonstrate small but consistent gender differences

Different Myers-Briggs scores: women more feeling (F), men more thinking (T)

Classroom Behaviors

Student-student interactions

- Males dominate group work; males dominate discussions; harassment and teasing; peer culture

Teacher-student interactions

- Males tend to monopolize teacher attention (both positive and negative); males graded on content/ girls graded on appearance or behavior; differential expectations of boys and girls

Attitudes towards Science

1983 meta-analysis suggests no gender difference, a 1995 meta-analysis found more positive attitudes among boys; research still inconclusive

Possible age-gender interaction/ rates of development

1995 analysis found positive correlation between attitude and achievement; higher correlation for girls

"Self" Variables

- Females tend to attribute success to luck or effort, males attribute success to ability
- Feelings about science due to sex-role stereotyping
- Decrease in confidence and academic risk-taking as girls get older
- Middle school is the diverging point for science

Gender and Problem-Solving

Higher problem-solving achievement among males than among females

How you ask the question may affect student responses

Gender and Learning

All of these are factors which could affect learning. But…research in these areas is often inconclusive. Overall picture suggests that males and females may learn differently.

The context of being male or female interacts with the classroom and society to affect learning; as teachers we need to be aware of how our actions, classroom, and culture affect our students.

Video

Watch first scenario; make a list of those things you feel are making this a hostile classroom (for females and males)

Watch second scenario; what changes were made?

Discussion

What classroom behaviors will help your female students succeed in science?

Will these only help the girls, make boys do worse, or help both?

Helping girls succeed

- Role models/mentors
- Advisement and administration
- Harassment-free classroom environment
- Motivation and self-esteem

Helping girls succeed

Cooperative learning: burden or blessing?

- Heterogeneity is the rule, except…

Respect learning differences

- Multiple types of activities and assessments

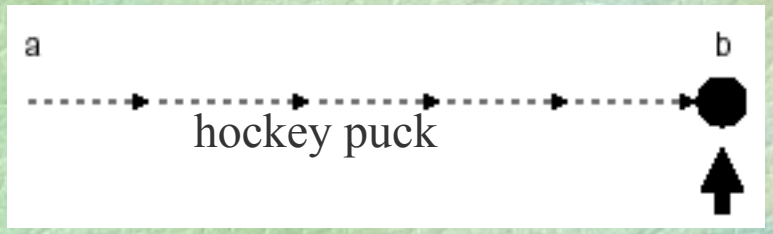
Textbook, curricular and media images

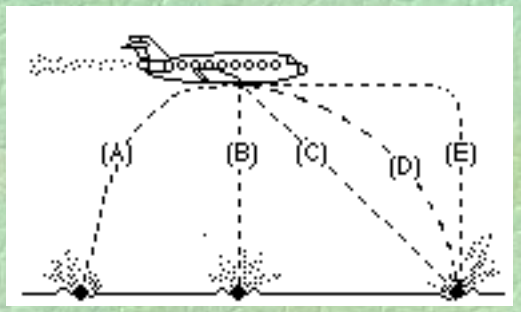
- Beakman & Jax, Bill Nye the Science Guy
- Context and gender in physics

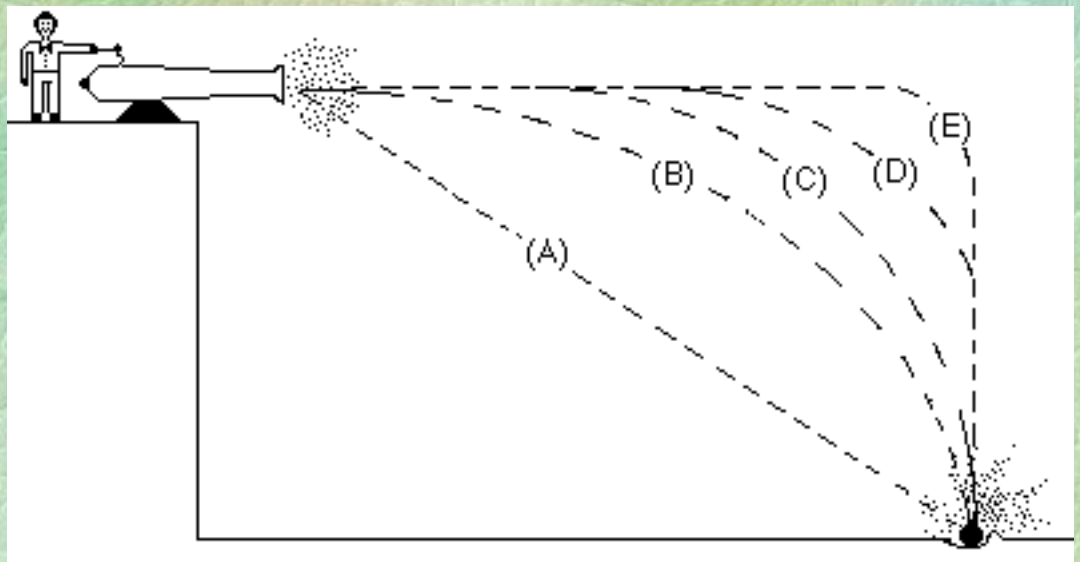
Can context affect response?

- Popular physics assessment: the Force Concept Inventory
- 30 question, multiple choice, no math
- Females do worse than males on the FCI
- What does the test look like?

FCI contexts







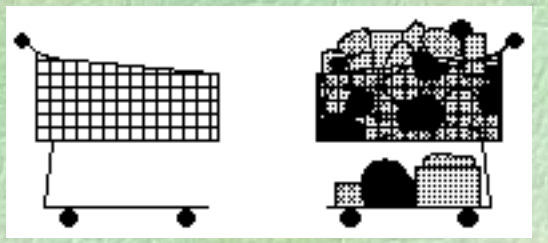
FCI by males, for males?

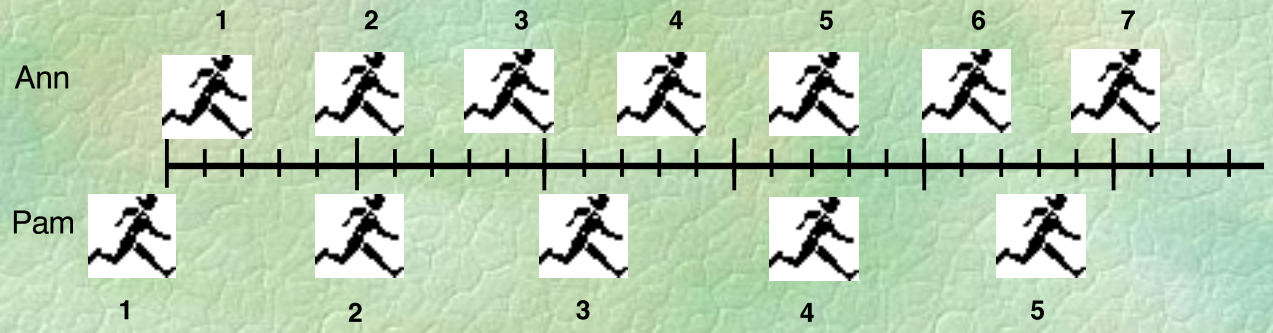
- Stereotypically male contexts
- Almost every person is a male
- Written by a team of male physics education researchers
- Male contexts → female disadvantage?

How to test context?

- Change the context!
- New version of FCI with stereotypically female contexts
- As far towards a female bias as possible
- Also more daily-life situations

New FCI contexts



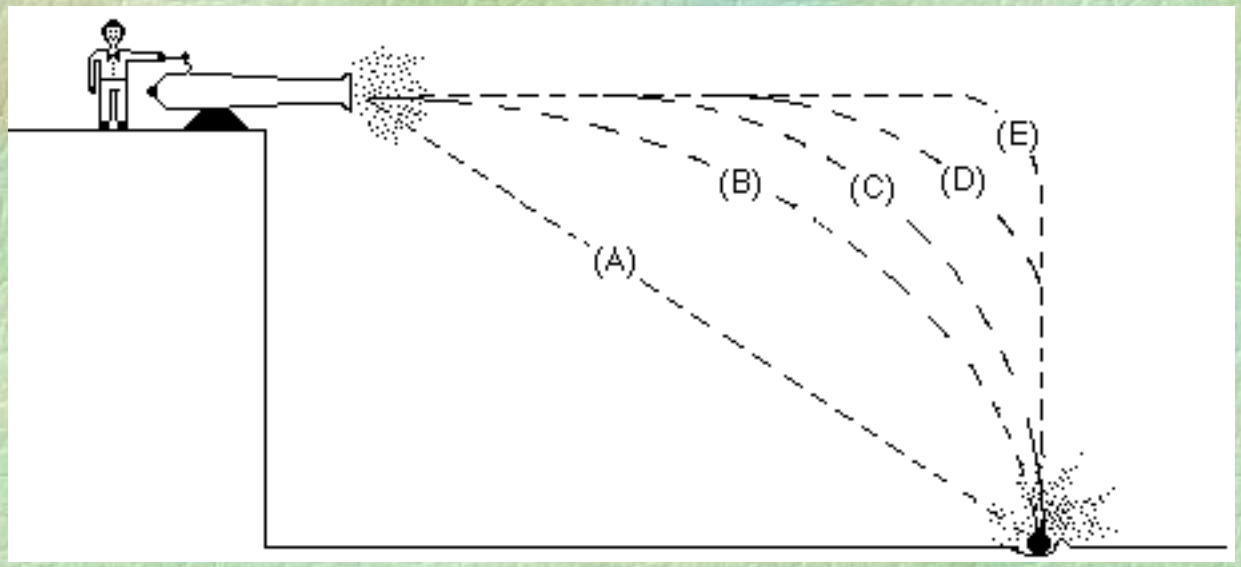


Overall comparison

FCI score-UW-Stout	Original	Revised
Women	21.7	22.4
Men	33.7	28.5

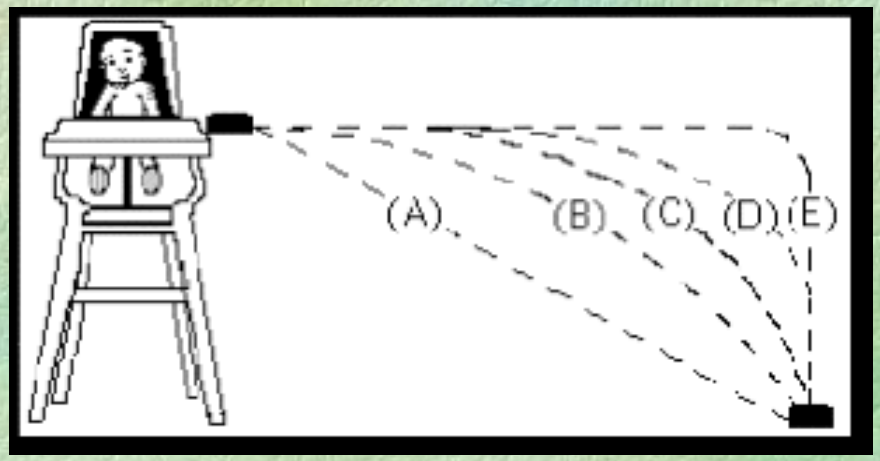
Original Question

A ball is fired by a cannon from the top of a cliff as shown in the figure below. Which of the paths would the cannonball most closely follow?



Revised Question

A baby in a high chair slides her bowl of food horizontally off the side of her flat tray with a quick push. Which path below best represents the path of the bowl?



Results-cannon/baby

% correct (B)	Original	Revised
Women	34	51
Men	66	66

Women did much better, men did the same on the revised version.

Original Question

In the figure at right, student "a" has a mass of 95 kg and student "b" has a mass of 77 kg. They sit in identical office chairs facing each other.

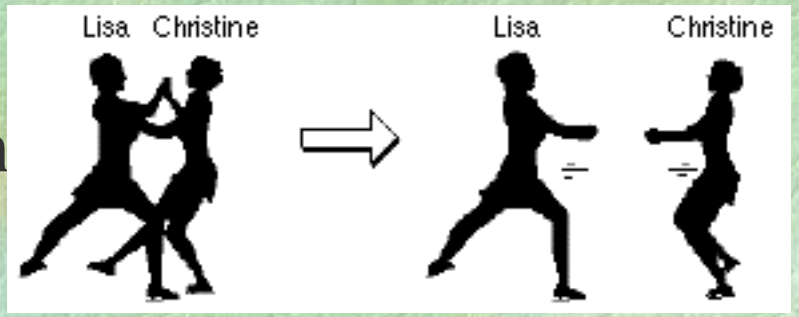
Student "a" places his bare feet on the knees of student "b", as shown. Student "a" then suddenly pushes outward with his feet, causing both chairs to move.

During the push and while the students are still touching one another:

(a) 0 force
(b) a on b but not b on a
(c) b > a
(d) a > b
(e) a = b

Revised Question

Two figure skaters, Lisa who has a mass of 95 kg and Christine who has a mass of 77 kg, are standing on the ice with Lisa's hands braced against Christine. Lisa suddenly pushes off of Christine, causing them both to move.



During the push and while the skaters are still touching one another:
(a) 0 force
(b) a on b but not b on a
(c) b > a
(d) a > b
(e) a = b

Results-skaters

% correct (E)	Original	Revised
Women	5	10
Men	23	17

Women did better on the revised version, men did worse on the revised version.

Context matters!

- How you ask a question can affect student response
- Students' prior experiences, culture can have a profound effect on their learning (Thailand example)
- We need to watch our contexts, analogies, and descriptions

Girls can do science

By creating a friendly learning environment, girls can succeed in science

9th grade is a critical time for science and girls

It's very important that we encourage every person to learn science and tell them that anyone can be a scientist