

Physics Teaching Around the World

Wednesday, Jan 28, 2004 12:30 - 3:30 PM

a) Student Understanding of Gauss' Law and Charged-Particle Trajectories in Regions of Magnetic Field

Gordon J. Aubrecht II, The Ohio State Univ

Students typically have difficulty with fields and Faraday's law. They tend to think of fields as static. The connection between Maxwell's equations and derived laws is tenuous. Another area of misunderstanding is the geometry of the Lorentz force law.

A group of 74 US students and 52 Romanian students were each given the same multiple choice questions. Romanian high school physics is generally considered to be equivalent to US first and second year university physics. Hence, one would expect that the Romanian students would make a much stronger showing than US students.

The question: A conducting sphere with a total charge $+Q$ of radius a is surrounded by an insulating spherical shell of radius b , which is surrounded by a further conducting spherical shell of radius c . Determine the electric field if a) $r < a$, b) $a < r < b$ and c) $b < r < c$.

Answers: a) 0 b) $\frac{kQ}{r^2}$ c) 0

16% of US students and 25% of Romanian gave mostly correct solutions. None in either group gave a completely correct solution.

Second Question:

Determine the direction of the electromagnetic force acting on and the trajectory of a particle with charge q moving at speed v in relation to a magnetic field B and an electric field of zero for the following conditions.

- a) $v = 0$ b) v parallel to B c) v perpendicular to B
d) v and B meet at angle α

Correct answers are summarized:

	US	Romanian
a)	81%	44%
b)	78%	37%
c)	57%	50%
d)	60%	25%

b) Thinking Like a Physicist

Goran Grimvall, Royal Institute of Tech

Physicists and engineers use various techniques to reconcile physics with reality. We are in search of a "grammar" for physics and engineering science thinking (see the Physics Teacher Jan 1995). This grammar will include principles, modelling, quantifying, Fermi problems and dimensional analysis.

Example: the ball used for the hammer throw must have a centre of gravity not more than 6 mm from the geometrical centre of the sphere. How can we test each ball quickly under field conditions?

Principle: the support area for a solid must inclose the centre of gravity. Place the hammer throw ball on a tube 12 mm in diameter. If it does not fall off, regardless of orientation, it is a legal ball.

Another example: a block of wood 5 cm thick is floating in a liquid such that 2.5 cm is immersed, and 2.5 cm is above the surface. A second identical block is placed on top of the first. How deep will the first block sink?

Answer: 2.5 cm. In a real situation, putting the second block on top of the first results in an unstable situation. The first block tips, allowing the second to slide off.

Body Mass Index (BMI) = $\text{Mass}/\text{height}^2$ BMI>25 indicates overweight, >30 indicates obesity.

Fermi Questions:

Have we printed enough newspapers to cover the Earth?

How much energy does a bicyclist use in the lifetime of a bicycle, compared to how much energy went into its construction?

How many of the water molecules in a given glass were in the blood of Socrates when he died?

c) Physics Education in Zambia

Kenneth Cecire, Hampton Univ

In Zambia, 85% of the population have some education, 6% have some secondary, and 0.4% have some post-secondary. There are gateway exams at various points. Fail one, and you are finished.

72% of parents favour caning.

95% of parents favour uniforms.

Physics teachers are 95% male. 35% have a B.S. or B. A. 20% have been trained to teach physics. Lectures are the predominant strategy.

US/Zambian teach collaboration efforts have taken place. There are problems in being seen as a "donor" group. The most effective approach seems to take a section of the curriculum, and work on that.

More information is at <http://www.jlab.org/~cecire/cosmzambia/cosmzambia.html>.

d) Interactive Engagement vs. Traditional Pedagogy in Russian High School Physics Classes

Katya Denisova

Herzen State Pedagogical Univ. of Russia, Walbrook Uniform Services Academy

The stereotype of Russian students is strong mathematical ability. The real story is:

- qualitative educational research is not taken seriously
- inertia of post-Soviet establishments
- little use of inquiry
- little hands-on
- fear of punishment for wrong answer
- interest in physics decreasing

Research project: does the interactive engagement approach produce an improvement over the traditional Russian approach?

143 students were in control groups, and 146 in experimental groups. Both were taught by the same teacher in 7 different high schools. The curriculum was elementary mechanics.

	Pretest	Post Test	Gain	Mean Gain
Experimental	18%	66%	48%	0.58
Control	18%	35%	17%	0.25

The study met with a fair amount of resistance from local educators.

e) The Effect of Participating in Workshops Tutorials on Exam Performance

Manjula D. Sharma, Univ. of Sydney

Features of the workshops:

- team answer sheets
- staff talk to team as one
- no summative assessment
- attendance not compulsory
- solutions immediately available
- hands-on activities
- paper and pencil problems
- mix and match sheets to fit any course

Objective: improve engagement and enjoyment of physics.

- results show attendance improved exam scores
- students with poor high school marks do best working in core groups

f) Student Projects in Mexican Prep Schools

Guillermo Gonzalez-Cuevas

There are four levels of schools in Mexico: grammar, high, prep, university. Instructors at prep schools are university-trained, but not specifically trained as teachers. Projects built by students using simple, scrounged materials include a barometer, Galilean thermometer, measuring "g" using a toy helicopter, a Foucault pendulum and the Monkey/Hunter experiment.