Girls and education – physics not an option?

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Henriksen, Borg and Schreiner, 2008

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We will look at:

- Girls in upper secondary physics education – some statistics
- Factors influencing young people’s educational choice
- What is it about physics that makes girls turn away?
- How can we attract more girls to physics education?
Girls in upper secondary physics

Examples of proportion of girls in highest-level physics classes in some countries:

<table>
<thead>
<tr>
<th>Country</th>
<th>Course</th>
<th>Prop. Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td></td>
<td>22 %</td>
</tr>
<tr>
<td>Norway</td>
<td>&quot;Physics 2&quot;, optional in year 13</td>
<td>~30 %</td>
</tr>
<tr>
<td>New Zealand</td>
<td></td>
<td>~34 % *</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Israel</td>
<td></td>
<td>25 %</td>
</tr>
<tr>
<td>USA</td>
<td>Physics II / honors / AP physics</td>
<td>38 %</td>
</tr>
</tbody>
</table>

* Combined number for the two last school years
Am I interested enough?

Will the profession suit me?

How are the wages??

Am I clever enough?

Will I get a job?

What do professionals actually do at work?

Is it suitable for girls?

What’s the risk?

What will mum and dad think?

What do I have to sacrifice?

Will I find it meaningful?

Factors influencing choice
Factors influencing educational choice: Eccles’ expectancy-value model

Young people make educational choices based on:

- Task value
  - Attainment value (how important is it to achieve this aim?)
  - Intrinsic value (enjoyment)
  - Utility value (usefulness)
  - Cost (time and resource consumption, workload,…)

- Expectancy of success (based on previous experience, teacher and parent expectations, …)
Factors influencing educational choice:
Traits of youth in late modern societies

- Everyone wants to work with something worthwhile and fulfilling. What do girls in late modern societies find worthwhile and fulfilling? Postmaterial values: environment, justice, care for others,...

- Youth in late modern societies feel culturally liberated and build their identity (or so they feel) independently of home background, social class, parents’ interests and values and so on

- Creativity and innovation are highly valued (designers and movie directors are “heroes”)

- Youth express their identity through choice of
  - Music – clothing – friends – education
ROSE is an international comparative research project meant to shed light on factors of importance to the learning of science and technology (S&T) – as perceived by the learners. Key international research institutions and individuals work jointly on the development of theoretical perspectives, research instruments, data collection and analysis.
F. My science classes
To what extent do you agree with the following statements about the science that you may have had at school?
(Give your answer with a tick on each line. If you do not understand, leave the line blank.)

1. School science is a difficult subject .................................................................
   Yes ☑

2. School science is interesting .............................................................................
   Yes ☑

3. School science is rather easy for me to learn ..................................................
   Yes ☑

4. School science has opened my eyes to new and exciting jobs
   ............................................................................................................................
   Yes ☑

5. I like school science better than most other subjects ......................................

6. I think everybody should learn science at school .............................................

7. The things that I learn in science at school will be helpful in my everyday life
   ............................................................................................................................
I would like to become a scientist.
Working with something I find important and meaningful
Social worker, actor, singer – or work in a pet shop and help animals

Quotes from Schreiner (2007)
Who do you want to be when you grow up....?
Example from Norway:

Meteorology became a profession that suited a girl

Can physics do the same?

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What is it about physics that makes girls turn away?

Some research findings:

- Carlone (2003): "Prototypical physics" (physics envisioned as difficult, hierarchical, objective, etc.) is maintained and reproduced in physics classrooms, thus undermining the goals of a more inclusive physics.

- Angell et al (2004): Traditional “physics content knowledge" is emphasised over experimental, historical/philosophical and science/society approaches, and the subject seems to attract and reward pupils with this traditional orientation.

- Osborne & Collins (2001) described the British science curriculum as having "a foundationalist emphasis on basic concepts“.
What is it about physics that makes girls turn away? (cont:d)

More research findings:

- Boys and girls hold different notions of what it means to understand physics: Girls think they understand a concept only if they can put it into a broader world view, whereas boys appear to view physics as valuable in itself and are satisfied if there is internal coherence among the physics concepts learned (e.g. Stadler et al., 2000).

- Osborne & Collins (2001): Girls wish to know why things happen in science (the causal question) rather than only what happened (the ontological question).

- Girls, more than boys, emphasise a “social element” of knowing physics: understanding the world and explaining things to other people.
What is it about physics that makes girls turn away? (cont:d)

More research findings:

- Haüssler & Hoffman (2000): German boys' physics-related self concept was higher than their general school-related self concept, whereas the opposite was true for girls.

- Students in general, and girls in particular, regard physics as a particularly difficult subject with a high workload (e.g. Angell et al., 2004).
How can we attract more girls to physics?

Measures that have “proved” to help:

• Instructional materials addressing girls’ interests, such as the human body and issues of social relevance

• Teaching strategies that enhance the self-confidence of girls, like collaborative groups

• Strengthen girls’ self-concept in physics

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How to attract girls to physics (cont:d)

• Inform them about range of opportunities available in physics: Starting your own business based on a good idea; contributing to solving the world’s energy challenge, contributing to understanding climate, doing collaborative research (e.g. CERN), …

• Give them inspiring experiences with physics in school from an early age – through choice of physics education contents, contexts, and teaching approaches:
  – Relevant contents and contexts to the real world
  – Work forms that encourage cooperation

• Girls feel secure in choosing physics if encouraged by a person whom they trust (parents, teachers, advisers,…) -

• Inclusive, applications-rich physics teaching with frequent use of group work

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Showing how physics is relevant to girls’ aims, interests and identity

• Health, for instance medical imaging technology, cancer treatment

• Working together: Teamwork, e.g. in engineering, to achieve a common aim

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Showing how physics is relevant to girls’ aims, interests and identity (cont:d)

Visualize the kinds of tasks and the everyday working life of a (female) physicist

Demonstrate how creativity, innovation and entrepreneur-ship may also be realized through a physics career

Electronics graduates from Oslo developed technology for “zooming in” on sound and established a company

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Factors influencing recruitment, retention and gender equity in science, technology and mathematics higher education

EU-funded research project starting in 2009 with 6 European partners and ~ 30 international associated partners

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References


Henriksen, Borg and Schreiner, 2008