Recruitment and science for all: Some research evidence

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

http://www.roseproject.no

Young people's perceptions of school science?

The Draw-a-Scientist Test Unveils a not too positive Stereotype of Scientist
Children's perceptions of school science
Murphy & Beggs, 2003. School Science Review, 84(308)

Figure 2: Children's enjoyment of school science.

Figure 3: Differences between boys and girls.

Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Boys</th>
<th>Age 1</th>
<th>Age 2</th>
<th>Age 3</th>
<th>Age 4</th>
<th>Age 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>2</td>
<td>64</td>
<td>44</td>
<td>25</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>SO-motivation</td>
<td>8</td>
<td>65</td>
<td>57</td>
<td>8</td>
<td>&lt;1</td>
<td>37</td>
</tr>
<tr>
<td>Attention (8)</td>
<td>8</td>
<td>41</td>
<td>69</td>
<td>72</td>
<td>52</td>
<td>43</td>
</tr>
</tbody>
</table>

SECURE is a collaborative project under FP7 to provide research results of current mathematics, science and technology (MST) curricula across Europe. The research focuses on the MST curricula offered to 5, 8, 11 and 13 year-old learners in ten European countries. The consortium invited 60 schools from each partner country to participate in the project. Altogether almost 9000 pupils, 1500 teachers and 600 schools took part in the study.

The study took place in ten European countries (regions) of well-defined educational systems: Austria, Belgium (Flanders), Cyprus, Germany (Saxony), Italy, the Netherlands, Poland, Slovenia, Sweden and the United Kingdom (England). The research involved learners of ages 5, 8, 11 and 13.

Recruitment and educational choice in STEM

- Women are under-represented in physical, mathematical and engineering occupations
- For the EU-27 countries, ca. 1/3 of PhDs in 2006 within physical science, mathematics and statistics was earned by a woman
- For computing: around 1/5 of PhDs by women.
A description of the situation

"Education at a Glance" (OECD, 2008):

The proportion of females among students entering tertiary science studies ranges from less than 25% in Japan, the Netherlands, Switzerland and Chile to more than 35% in Denmark, Iceland, Italy and New Zealand.

The 1927 Solvay congress

Physics conference 2008

conference on Disorder, fluctuations and universality
Called for a substantial increase in the percentage of STEM professionals in the workforce
Increasing the number of women would go a long way towards meeting this challenge

Attitudes towards science: a review of the literature and its implications
Osborne, Simon & Collins INT. J. SCI. EDUC., 2003, VOL. 25, NO 9, 1049–1079

<table>
<thead>
<tr>
<th>Country/region</th>
<th>Number of engineers and scientists per million of the population (1993)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>5446</td>
</tr>
<tr>
<td>The US</td>
<td>2645</td>
</tr>
<tr>
<td>Europe</td>
<td>1352</td>
</tr>
<tr>
<td>Latin America</td>
<td>209</td>
</tr>
<tr>
<td>Asia</td>
<td>99</td>
</tr>
<tr>
<td>Africa</td>
<td>55</td>
</tr>
</tbody>
</table>
Development of school students' constructions of biology and physics
Spall, Illustrious, Dillou & Joyce, INT. J. SCI. EDUC., 31(6), 2017, 787-803

Attitudes towards science: a review of the literature and its implications

Attitudes towards Physics
REID & SKYARINA, Research in Science & Technological Education, Vol. 20, No. 1, 2002

What happened during the second half of the 20th century?
(Data from Scardamalia, 1996; Scottland, 2000; in England and Wales at A-level.) (Data provided by UK Examination Boards and HMSO.)
The loss of interest in higher education in the sciences is, in Germany, part and parcel of a cyclical process of enrollments in the disciplines in question. The process is not compatible with the image of a medium- or long-term trend or with the image of a recent change.

It is much more in line with the cobweb model in which there is a cyclical alternation of interest and loss of interest in this area of education.

Trend, Change or Cycle?

Intagna till några gymnasieprogram (1994 – 2011)
Examina från universitet och högskolor (1997/98 – 2008/09)

- Consortium Oslo university
- Started 1st of may 2009
- Fp7 “Science in Society”
- Total 1 million EUR 3 yr, 6 partners in Europe
- IRIS international – 20 more countries...


6.6. Hur viktiga har följande skolorfarenheter varit för ditt val av utbildning/hem?

- 1. Ditt intresse för ämnet
- 2. Dina tidigare prestationer i liknande ämnen
- 3. Experiment/Laborationer
- 4. Exkursioner och studiebesök
- 5. Lektioner som visade ämnets betydelse för samhället
- 6. Lektioner som visade ämnets tillämpningar
- 7. Användandet av matematik på lektioner
- 8. Tydlig återkoppling om att du fått fram rätt svar
7.7. Hur viktiga har följande personer varit för ditt val av utbildning/kurs?

<table>
<thead>
<tr>
<th>Person</th>
<th>Viktighet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mamma eller styvmamma</td>
<td>1</td>
</tr>
<tr>
<td>Pappa eller styvpappa</td>
<td>2</td>
</tr>
<tr>
<td>Duktiga lärare</td>
<td>3</td>
</tr>
<tr>
<td>Vänner (inklusive pojkvän/flickvän)</td>
<td>4</td>
</tr>
<tr>
<td>Syskon eller andra släktingar</td>
<td>5</td>
</tr>
<tr>
<td>Studie–och yrkesvägledare på skolan</td>
<td>6</td>
</tr>
</tbody>
</table>

9.8. Hur viktigt har följande varit för ditt val av utbildning/kurs?

<table>
<thead>
<tr>
<th>Aktivitet</th>
<th>Viktighet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Populärvetenskapliga böcker och tidningar</td>
<td>1</td>
</tr>
<tr>
<td>Science fiction eller fantasy böcker/filmer</td>
<td>2</td>
</tr>
<tr>
<td>Datorspel</td>
<td>3</td>
</tr>
<tr>
<td>Museum eller science center (t.ex. Tom Tits eller Universeum)</td>
<td>4</td>
</tr>
<tr>
<td>Populärvetenskapliga TV-kanaler/program (Discovery channel, MythBusters, Animal planet, TV4 fakta, Kunskapskanalen)</td>
<td>5</td>
</tr>
<tr>
<td>Filmer eller TV-serier (CSI, Numbers, Grey's Anatomy osv)</td>
<td>6</td>
</tr>
<tr>
<td>Ämnesrelaterade tävlingar som kemiolympiaden, teknikåttan eller unga forskare</td>
<td>7</td>
</tr>
<tr>
<td>Någon annan aktivitet som vetenskapsfestivaler, forskarfredag eller liknande</td>
<td>8</td>
</tr>
</tbody>
</table>

What's in it for me?
Norwegian students’ choices of post-compulsory science in an expectancy-value perspective
Maria Vetlesen Bøe

No man is an island
Significant persons' influence on young people’s attitudes towards and choice of education within science, technology, engineering and mathematics
Jørgen Sjaastad

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Understanding Student Participation and Choice in Science and Technology Education
Editors: Henriksen, Elin K.; Dillon, Justin; Ryder, Jim (Eds.)
Science and technology is important for society
A country needs science and technology to become developed.

Science and technology will find cures to diseases such as HIV/AIDS, cancer, etc.

School science has opened my eyes for new and exiting jobs.
I would like to become a scientist

I would like to get a job in technology

Grand mean of all items on Interest vs. HDI (Human Development Index)
Correlation among countries between interest and achievement in PISA 2006

PISA 2015
Students interest, motivation and Self-Efficacy
Important but not for me:

Students' attitudes towards secondary school science in England


These responses reflect fundamental issues about the purpose, nature and content of school science education—issues that are currently receiving more attention than at any time since science was first schooled in the midnineteenth century /…/. In somewhat simplistic terms, many recent science curriculum initiatives might be described as attempts to ‘humanise’ school science education /…/

these findings are common to many industrialised countries /…/
any explanation of students’ reluctance to pursue careers in science and technology may lie as much outside the school system as within it.
/…/ responses to the ROSE questionnaire from students in developing countries (Sjøberg et al., 2004) suggest that this is indeed the case.

Different countries, Same Science Classes

Hur elever upplever sin NO-undervisning


Går igenom en mängd studier och fokuserar data från Sverige (Lindahl), England och Australien

Identifierar tre teman som är gemensamma för de senare delarna av den obligatoriska skolan (high-school):

Transmissive pedagogy (bara lär dig, fråga inte varför, skriv ner)
Decentralized content (personlig irrelevans)
Percieved difficulty (meningslösa fakta utan diskussion)

Diskussion om vad som ska få styra innehållet i skolan:
Elevernas intressen eller universitetens egenintressen

Toward a more authentic science curriculum:

The contribution of out-of-school learning


Student’s reluctance to pursue science needs to be related with "site of learning"?

Relate science education with societal development. Working life and “informal settings” expand (TV, Internet, social media etc…).
Since “the nature of science” change “the nature of learning science” need to be in update with this development.

Real problems, real challenges, broad connections with "outside school"
More smiles on our faces!

International understanding

Enjoyment of life
Participation
Trust
Empowerment

1900 1950 2000

Information
Research
Business
School – Education

Enjoyment of life
Participation
Trust
Empowerment