

*Building the Scientific Mind through planned  
intervention in structured settings*

# Convergence and Divergence in Children's Attitudes Toward the Sciences and Science Education

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# *Connection to BtSM Aims*

1. Determine the conditions that foster development of the scientific mind:  
formal settings
2. Establish practical ways to improve and complement existing efforts to develop the scientific mind
3. Break open the too narrowly defined research agendas and practices

# *Science and the economy*

- In the UK, there will be a 12% increase in demand for Science professionals from 1996-2006
- Number of scientists per million of populace (1993):

Japan	3500
USA	2700
Europe	1600
Latin America	209
Asia	99
Africa	53

# *Attitudes*

- Express our *evaluation* of something or someone
  - evaluative consistency
  - Target
- Stable: Once acquired, they are hard to change
- Lack of generally accepted terminology -  
(Encyclopædia Britannica Online)

# *Why attitudes matter*

1. The “swing from science”
2. Attitudes impact implicit motivation, which impacts
  - academic effort
  - future activities in school and society

**Attitude toward Science  
and Science Education**



**Intrinsic Motivation**



**Enhanced Effort &  
Processing**



**Continuing Motivation**

# *The good news*

- Applications-based Physics course results in positive attitude toward Physics
- Attitude strongly impacted by quality of teaching - In our control
- Much evidence that students feel science is useful and interesting
- % of girls going into science-related fields in the UK has increased from 1979-2000

# *The not-so-good news*

“the absence of history or context, the tyranny of technique, the isolation of the learner and the struggle to attend in a sea of inattentiveness”

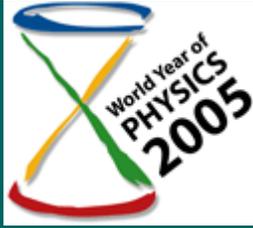
- Student explanation for turning away from Science in college (Tobias, 1990)

# *The not-so-good news*

- The number of students taking science and math at A-level (in the UK):
  - 42% in 1963
  - 16% in 1993.
- One of the variables most strongly impacting attitudes is gender
- Attitude toward (school) science declines with entry into secondary school
  - especially for girls

# *The not-so-good news*

- Recognized value of science does not imply appreciation for science education:
  - 72% of sample indicated science is important
  - 40% of sample indicated science class is boring (Ebenezer and Zoller, 1993)
- Boys have a consistently more positive attitude toward school science than girls
  - effect is stronger in Physics than in Biology
  - effect is strongest in general science (Weinburgh, 1995)



# World Year of Physics

- % of girls in Physics college degrees is **not** increasing in the UK
  - Rates *have* increased in all other science programs
- Male:female ratio:
  - Physics is 3.4:1
  - Biology is 1:1.6
- Physics rates poorly in terms of attitudes:
  - 50% do not enjoy Physics at all or very little
  - 60% enjoy Biology quite a lot

# *World Year of Physics*

- Scotland & The Netherlands
  - attitudes toward Physics *not* lower
  - Physics taught by qualified Physics teachers
- Decision to pursue Physics most strongly impacted by math and science scores
  - Reinforcing that physics is for the intelligent, and therefore difficult

# *The unexpected news*

- “Science after Grade 10 will cheat me out of well-rounded liberal education”
  - Girls: limited to unappealing scientific careers
- Survey of students who dropped science courses:
  - 71% rated science as interesting
  - 79% felt practical work was enjoyable
  - 76% felt that it helped you to understand things in everyday life

# *The unexpected news*

- Curriculum materials and instructional techniques doesn't seem to significantly impact student attitudes
  - as opposed to teaching quality
- Lower SES associated with higher interest in school science
- Science attitudes may not be correlated with achievement
  - Children can achieve in school science without a positive attitude

# *The useful news*

- Science attitude most strongly affected by **science teaching**
- Most positive attitudes toward school science with:
  - High level of involvement
  - Very high level of personal support
  - Strong positive relationships with classmates
  - Use of variety and unusual techniques
- Teachers are happiest and most enthusiastic when teaching the subject they **specialize** in

# *What “BtSM-ers” might explore & ask questions about*

1. Scientific training is a type of education that produces a “useful specialist” but not “a truly educated man” (Mathew Arnold, 19<sup>th</sup> Century)
  - What are the implications for BtSM?
2. Difference in girls and boys attitudes toward science courses is strongest in general science
  - Does this doom girls in developing nations, where few make it past general science courses?

# *What “BtSM-ers” might explore & ask questions about*

3. “Actual experience with science at school does not seem to be related to attitude toward science as a worthwhile societal enterprise...Science at school should and science out of school should be treated as distinct and separate entities”
  - Is this really what we should be doing?
  
4. The smallest school
  - How do we use ensure it contributes to BtSM?

# *What “BtSM-ers” might explore & ask questions about*

5. “The essential irony of a discipline that offers intellectual liberation from the shackles of received wisdom is that the education it offers is authoritarian, dogmatic, and non-reflexive”
  - What can be done to modify this?
  
6. Little is known about how and why attitudes toward science change.
  - Attitudes are integral to BtSM. Knowledge is often ephemeral. How can we bring clarity to this topic?