Proceedings

Getting Science Out of its Masculine Strait Jacket

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Summary. *School science becomes masculinised through: the predominance of males working in science; the way science is "packaged" for teaching and learning; classroom interactions which reinforce stereotyped expectations and the way science itself is conceived and practised. Each of these aspects is expanded in this paper and suggestions made which may couteract masculinising effects and enable girls and women more comfortably to pursue careers in science. These involve taking steps to make women scientists visible, to teach science in a social context and to encourage problem solving, collaborative working and discussion.*

Keywords: science, social-context, person-orientation, gender-stereotyping, strait-jacket.

What does it mean to say science is in a strait-jacket? A strait-jacket implies confinement and loss of freedom. To label it masculine implies that confinement arises from science taking on masculine characteristics. What evidence is there that science is in a masculine strait-jacket and what can we do to extract it?

As a result of a major four year action research project in England (the GIST project: Girls into Science and Technology), Kelly (1985) argued that secondary school science becomes masculinised in four chief ways:

- Numbers

The scientists students meet, in texts, media, in person and among teachers are usually men;

- Packaging

Examples used in text-books or by the teacher, are more usually drawn from activities that boys, rather than girls, engage in;

- Interactions

In a co-educational class, boys claim laboratories and workshops as their territory;
Students and teachers reinforce gender-stereotyped behaviour;

- The Nature of Science

The way science is practised: its principles, concepts and methodology are biased toward the male.

Let us look in more detail at each of these, for each contributes to the confining of science within a masculine framework.

The Predominance of Men

The position today, where there are many more men than women scientists, is a product of past gender-stereotyping, which first deliberately excluded women and later failed to remove obstacles to women, such as gendered expectations of the appropriate roles for men and women in the world.

But there are women working as scientists at all levels. We need to make them more visible. Text-book publishers should ensure that men and women are equally presented doing serious science, with as many women as men identified in leadership positions and as many men as women in support situations, such as technician or secretarial/administrative roles. All careers information should show females and males participating in each occupation featured.

The GIST Project invited women scientists and technicians into the project schools to teach pieces of science related to the work they were doing. But they found that unless attention was drawn especially to the fact that they were women, many of the students, particularly boys, did not remember the presenter was a woman. In another project in Wales, a woman airline pilot and a woman chief steward were both remembered by girls as air hostesses! *Such is the strength of stereotypes.* To change them, we need both to make women scientist/technologists visible and continue to refer to them in these roles.

Packaging

An analysis of text-books, especially in the physical sciences, show that while illustrations feature more males, in many, few people are included. Collings and Smithers (1984) showed that boys have significantly lower person-orientation than do girls, and the student scientists of each gender score less on a person-orientation scale than those choosing arts subjects. By presenting science in an impersonal way we may be attracting into it young people, mostly males, who have little concern for people.

The situations or technologies used to explain topics in science more often reflect the way boys are connected to the world (e.g. football, machinery, ballistics etc.). While boys and girls do express different interests there are aspects of science that both genders would like to know more about (Whyte, 1986; Lie and Bryhni, 1983). These common aspects may vary between cultures. Surveys need to be carried out in Malta to discover components of these common interests.

On the other hand, the problem may lie in the motivational or entry point. In the UK, electronics is one of the least popular subjects with girls. We were surprised, therefore, when we investigated young people's entries to a National Design Prize Competition, to find a majority of girls and boys who entered were using microprocessors in some form of control technology situation. But the gender difference emerged in the way they defined the problem they had worked on. For the boys, the problem was a technical one, they were improving a device; the girls, however, saw a social problem (helping a young child to learn or a disabled person to be more independent). Once the girls recognised that electronics could help them solve this problem they had no difficulty working with it (Grant and Harding, 1987).

A pre-university course in Victoria, Australia, requires physics to be learned 'in context'. The structure of the atom can be investigated either through the debate over nuclear energy or through the atomic bomb. If students choose the latter, the brief runs like this: *'you are asked by a group of non-science students, who plan to visit Hiroshima, to fill them in on the development and use of the atomic bomb'*. The physics content of this course is traditional but, in the first two years of its use (1992/93) students have shown a substantial increase in A grades gained. This is particularly marked for females (Hildebrand, 1996). By relating science to people's needs and placing it in a social context we can remove many of the masculine constraints on science.

The dominant behaviour of boys and the need to breakdown stereotypes

The effect of the behaviour of boys on girls' learning in science classrooms is irrelevant in the single sex environment of Maltese secondary schools, but stereotyped expectations of both girls and boys may operate in these settings. I understand that different curricula are available for girls and boys in the 'area secondary' and trade schools (Darmanin, 1992), although all curricular areas are theoretically open to both sexes. In common with other national governments, Malta has signed the 'Platform for Action' agreed at the 1995 UN Fourth World Conference on Women. This places special emphasis on widening girls technical and vocational education and on educating boys in home-crafts.

Early stereotyped experiences may strongly influence relative achievement of girls and boys in a number of topics of the science curriculum (Harding, 1996; Johnson and Murphy, 1986). Electricity is one such topic - and was chosen, for this reason, by Parker and Rennie (1985), in an action research project in Western Australia, which addressed three issues with grade 5 teachers: the development of skills and attitudes relating to the teaching of electricity; the development of positive teachers' attitudes towards the participation of girls in the physical sciences; and the development of skills in creating and maintaining a non-sexist learning environment. This project enabled ten-year-old girls to achieve parity with boys in the assessment of work in electricity.

In the co-educational context of Maltese primary schools also, teachers need to develop skills to create and maintain a non-sexist learning environment, especially when presenting science topics for learning.

The 'ideology' of science and implications for science education

A common perception of science is that it consists of a set of immutable laws which are generalised and abstracted from contexts. Too often science education consists of the presentation of these laws for practical demonstration and their use to solve paper-problems. Objectivity is assumed to require separation of the observer or experimenter from the object or system investigated. Emotions have no place in the pursuit of science.

The effect of these perceptions on recruitment to science was investigated by Head (1980, 1985). He reviewed studies of the personality of practicing scientists (all male) carried out since the Second World War. He found that scientists emerged as more authoritarian, more emotionally reticent, more imbued with the Puritan work ethic and less person-orientated than their male peers. His investigations of teenagers found that the boy scientists were among the least mature of their age group, whereas the girls choosing science, though fewer in number, were among the most mature. He argued that a girl had to have a certain maturity to make what was then an unconventional choice, whereas science, presented as law-bound, unemotional and reliable could provide the less mature boy with the certainty that spelt security.

How does this selective recruitment affect the practice of science?

Both Keller (1985) and Harding (1986) argue that the differential nurturing of males and females develops different psychological, emotional and cognitive needs (if not abilities). Keller sees the male's greater need to dominate and control has led to the dominance of the master molecule concept in biochemistry and genetics. This, she argues was a factor in the delayed recognition of the work of Nobel Prize-winner, Barbara McClintock. For McClintock, the most important principle was variation and difference, not generalisation and abstraction. Neither did she strive to distance herself from the systems she studied. She felt she was down in the cells with the chromosomes. She had 'a feeling for the organism' and would say *'Let the material tell you what to do'*. In this way she was able to observe the transposition of genetic material between chromosomes when ideologically it could not happen.

Keller argues that the history of science demonstrates that

science has been pursued, and knowledge generated, in many different ways. By allowing science of the 'Enlightenment' to become the dominant way, with its strongly masculine overtones, science is constrained in a strait-jacket.

Could science be different if more women were involved? It is difficult to say, as most women who remain in science have adapted to the system. But if we modify the way we teach science we may enable more women, and males with different psychological and cognitive needs to pursue it.

Removing the strait-jacket

The following factors have been found to associate with girls' greater enjoyment and success in science:

- the placing of science in the social context;
- the avoidance of vocabulary, technical terms and meanings that derive from a peculiarly shared masculine experience;
- the integration of **their** experience of the world into the learning process;
- the use of a framework that allows them to recognise complexity and ambiguity;
- the opportunity to reflect, work collaboratively (and therefore discuss) and to define a problem in their own terms;
- the expectation that they will participate and achieve success.

Ventura (1992) reported that Maltese girls were less successful in 'O' level physics than were boys and that Form 4 girls performed badly across all sciences in secondary schools. Perhaps the masculine strait-jacket is operating and presentation of the sciences at this level does not take the above factors into consideration.

References

Collings J and Smithers A (1984) Person orientation and science choice. *European Journal of Science Education*, **6**, 55-65.

Darmanin M (1992) The labour market of schooling: Maltese girls in education and economic planning. *Gender and Education*, **4**, 105-126.

Grant M and Harding J (1987) Changing the polarity. *International Journal of Science Education*, **9**, 335-342.

Harding J (1996) Science in a Masculine Strait-Jacket. In: *Gender, Science and Mathematics* (Eds L Parker, L Rennie and B Fraser). Kluwer Academic Publishers, Dordrecht, Boston and London.

Harding J (1986) The Making of a Scientist. In: *Perspectives on Gender and Science* (Ed J Harding). Falmer Press, Sussex, UK.

Head J (1980) A model to link personality characteristics to performance in science. *European Journal of Science Education*, **2**, 295-300.

Head J (1985) *The Personal Response to Science*. Cambridge Science Education Series, Cambridge University Press, Cambridge, UK.

Hildebrand G (1996) Redefining Achievement. In: *Equity in the Classroom* (Eds P Murphy and C Gipps). Falmer Press, Sussex, UK.

Johnson S. and Murphy P. (1986) *Girls and Physics: Reflections on APU survey findings*. APU Occasional Paper 4, Department of Education and Science, London, UK.

Eller E F (1985) *Reflections on Gender and Science*. Yale University Press, Newhaven and London.

Kelly A (1985) The construction of masculine science. *British Journal of Sociology of Education*, **6**, 133-154.

Lie S and Bryhni E (1983) Girls and Physics: Attitudes, Experiences and Underachievement. In: *Contributions to the Second GASAT Conference*. University of Oslo, Norway.

Parker L and Rennie L (1985) Teacher In-service as an Avenue to Equality in Science and Technology Education. In: *Contributions to the Third GASAT Conference*. Chelsea College, University of London (available ERIC, Ohio University).

Ventura F (1992) Gender, science choice and achievement: a Maltese perspective. *International Journal of Science Education*, **14**, 445-461.

Whyte J (1986) *Girls into Science and Technology*. Routledge and Kegan Paul, London, Boston and Henley.