Toward Feminist Science Teaching

by Irene Lanzinger

The social, historical and political factors that play a role in the construction of gender and science are reflected in the images of gender and science that schools reinforce. Feminist critics of science (Keller, 1986; Harding) would argue that these images reflect the androcentricty of science and play a role in the exclusion of women from the physical sciences. The task for feminist educators then is to imagine alternative methods of teaching science—methods designed to both alter the masculine image of science and make the physical sciences more inclusive of women.

Schools and the image of science

It is at school that we learn what science is and does. The white, middle-class, male bias of science is part of the societal status quo that is communicated by the school system. The hierarchy of the sciences is also taught. “Softer” biology is at the bottom and often taught by women. “Hard” mathematics and physics are at the top and almost always taught by men. As one moves up this hierarchical scale, the subjects require more objectivity, logic, and rationality—all qualities girls have been socialized to believe they do not possess. More mathematics is also required at the “higher” levels of the science scale. The media have aided the school system in convincing girls of “superior male mathematical ability.” (qtd. in Eccles and Jacobs) The perception persists in spite of the fact that nearly half of all bachelor’s degrees in mathematics are awarded to women (Fehrs and Czujko)—a figure three times higher than that in physics. Consequently, the numbers of girls choosing a particular science declines dramatically from virtually equal numbers in biology to very small numbers in physics. A male chemistry teacher in Britain describes this hierarchy:

Biology has never been short of capable and even outstanding girls. My answer is that the subject remains descriptive and more susceptible to rote learning than physics or chemistry. Girls remain conned into thinking that such intellectual activity is their forte. Chemistry has had a few female stars. They, in my opinion, resisted or ignored the social pressure which implies that chemistry is a man’s world—aggressive acids, nuclear power, menacing odours and some mental gymnastics needed to cope with the mole.... Physics has had even fewer girl successes. Here, however, the masculinity of the subject is more strident—electronics, speed, pressure and mathematics. (qtd. in Kelly, 1981)

School science courses mirror the public perception of science as objective, rational, and unbiased. They fail to include the social, historical, and political forces that form science. Any historical context referred to by high school science texts is peopled virtually entirely by men with the possible exception of Marie Curie. The many women who have made significant contributions to science throughout history remain invisible. (Rossiter; Abir-Am and Outram) The philosophy and politics of science are ignored completely. Students are often taught scientific theories as though they were truths rather than modifiable attempts at explanation of a very complex natural world. They are also taught that science brings technological progress along with the popular, public, Western myth that technological progress is intrinsically good (Rothschild) though some challenges to this may spring from the recent interest in environmental education.

There are many agents of androcentric science within schools. Biased textbooks, both those used in the classroom (Kelly, 1987) and those used in teacher education (Sadker and Sadker) contribute to the image of science held by both students and teachers. Teachers of science, ninety per cent of them men in British Columbia (Ferguson), have succeeded in and accepted traditional science. Real science—big industrial, military science—supported by capitalist politics and designed to promote and advance corporate interests is a long way from the classroom. This is not to say that teachers do not often provide examples of a military, industrial nature to their students. These examples, however, are viewed as applications of “pure” scientific research rather than examples of how military and corporate interests influence scientific research. The science taught in schools is an idealized version of real science albeit no less androcentric in essence.

Patriarchy in science classrooms

Schools provide a patriarchal context for the teaching of an androcentric science. Schools are places in which men
lead and women follow. Smith gives statistics for Canada that show that 96 per cent of high school principals are men. Lott gives similar statistics for the U.S., where 93 per cent of high school principals are men and 99 per cent of school superintendents are men. At the bottom of the school pyramid, the secretaries, teachers aides and cafeteria workers are, in vast majority, women. As Smith puts it: “Power and authority in the educational process are the prerogatives of men.” (29)

More than any other academic discipline, science has developed a discourse not intended for women. The language of science is one of control, domination and mastery—a language replete with technical terminology. In this language of science, the object of domination is nature (synonymous with women) and the dominating force is science as represented by men. It is not surprising that, contrary to the stereotype of verbal girls and mathematical boys, boys dominate classroom discussion.

Most teachers claim that girls participate and are called on in class as often as boys. But a three year study we recently completed found that this is not true; vocally boys clearly dominate the classroom. When we showed teachers and administrators a film of a classroom discussion and asked who was talking more, the teachers overwhelmingly said the girls were. But in reality, the boys in the film were outtalking the girls at a ratio of three to one. Even educators who are active in feminist issues were unable to spot the sex bias until they counted and coded who was talking and who was just watching. Stereotypes of garrulous and gossipy women are so strong that teachers fail to see this communications gender gap even when it is right before their eyes. (Salamon and Robinson)

We can expect this domination by boys to be most extreme in the science classroom and most likely it goes completely unnoticed, or is accepted as natural by the science teacher. The result is that in high school most girls choose to pursue other academic areas. Those girls who do persist often feel isolated, overwhelmed, and ignored. (Kelly, 1981)

Science is a discipline based on experiment. Whereas most teachers might be surprised to learn that boys dominate classroom discussion, they would probably readily admit that boys dominate the laboratory. Boys have learned to feel comfortable with mechanical toys and consequently mechanical tools. Boys transfer skills learned from mechanical and construction toys to laboratory equipment a good deal more easily than girls graduating from dolls and Little Miss Make-up. For girls, already isolated and dominated in the classroom, this adds yet another hurdle in the path of scientific knowledge.

Studies in the United Kingdom (Kelly, 1987) have shown that in single sex schools, girls are significantly more likely to study physics and mathematics even though girls' schools often have less than adequate laboratory facilities. In a study done in a co-educational school in which boys and girls were separated for mathematics the girls' attitudes and achievement in mathematics improved. These studies give some evidence that girls participation and performance in science might be influenced by gender hierarchies that exist in co-educational classrooms.

**The social and historical construction of science is an integral part of understanding the nature of scientific knowledge.**

How can we even begin to conceptualize science as nonmasculine, as somehow transcendentally pure and objective (nongendered), when most of written civilization—our history, language, conceptual frameworks, literature—has been generated by men? Who is the authority that, standing above the fray, has guaranteed that science alone is untainted by androcentric biases and patriarchal concepts and methods? (Bleier, 15)

Even if all science teachers were committed to feminist ideals they could not teach about a feminist science that does not exist. Indeed, the advisability of attempting to form a feminist science raises many important questions. (Harding; Keller 1986; Bleier) Teachers can, however, learn to include a feminist perspective on science. What is possible is the discussion of ways of balancing the inequalities in the classroom, of shifting the balance of power. Bias in textbooks and curricula can be reduced, or where it inevitably exists, can be commented on and discussed with students. Science can be made more palatable to female students. Feminists within the school system must content themselves with working for changes to bring the physical sciences within the “comfort zone” of the young women in their classes.

Students arrive in the high school science classroom with a strong sense of gender identity and a sense of what is appropriate behavior for their particular sex. This gender identity inhibits equity for boys and girls in the science classroom. The attempt to eliminate gender stereotyping in all schools is a necessary prerequisite to the equitable teaching of science in high schools. Young girls need to believe that the pursuit of a scientific career is appropriate and desirable.

**Teaching “real” science**

A major task of science teachers is to teach a more realistic version of science, as opposed to the idealized version usually presented to students. This idealization of science leads to the blind acceptance of scientific information. Perhaps even more dangerously, it leads to acceptance of the quasi-scientific information generated by advertising companies who
which they will be bombarded with contro-
for you, Ivory soap is 99 per cent pure,
cholesterol-free must therefore be good
to completely dry and rash free. Teaching an
idealized version of science leaves our
students ill-prepared for an adult world in
which they will be bombarded with con-
tradictory scientific information and need
to assess this information to make politi-
cal and practical decisions. For students
who find science difficult the picture of a
perfectly rational, objective science works
to undermine their confidence. Since there
can be nothing wrong with science there
must surely be something wrong with them.

Science teachers need to admit that
science is constructed by social, political,
and historical forces and as such is biased.
All science is practised from a particular
perspective and to varying degrees re-
fects that perspective. The teaching of
science should include a discussion of
various epistemological bases for science
and how these have influenced what kind
of knowledge is produced by science.

Students should be required to investigate
what the fundamental assumptions of sci-
ence are and should be encouraged to
discuss whether or not they believe that
these assumptions are historically or so-
cially determined. The social and histori-
cal construction of science is an integral
part of understanding the nature of scient-
tific knowledge.

A discussion of how science is influ-
enced by the worldview of the scientist
and how science reproduces social power
relationships (Fee) should be included in
the study of science both in high schools
and in universities. There are many exam-
pies of how scientists include their own
world view and social values in their
conclusions. Students should be exposed
to these as examples of “bad” science
but as examples of how scientists’ expe-
tations influence their work. The “confir-
mation” of the homunculus theory pro-
vides a wonderful example of this.

Microscopists of the seventeenth and
eighteenth centuries, including the great
van Leewenhoek himself, saw tiny men,
complete with arms and legs, when sperm
were viewed under the microscope for the
first time. Lest students believe that this
could not happen today, primatology pro-
vides a more recent example. In the study
of primates in the 1950s and 1960s fe-
males remained virtually invisible. If they
were observed, they were seen to fit the
cultural expectations that the scientists
had for female human beings. Only re-
cently has the behavior of female pri-
mates been recognized to include leader-
ship, dominance, aggression and initia-
tive. (Bleier)

The teaching of “real” science involves
not only the recognition that scientists’
observations and conclusions are coloured
by prevailing cultural norms but that virtu-
ally all aspects of the scientific enter-
prise are influenced by these norms. From
the wording of hypotheses, through data
analysis and interpretation, to publication
and popularization of results, every stage
of production of scientific information is
subject to political influence. Apart from

causing blatant errors in scientific find-
ings, the androcentric bias of science also
has a more subtle influence on the con-
struction of theories. In biology, the mas-
ter molecule description of DNA as a mol-
ecule with ultimate power and control
over all aspects of a cell or organism is an
example of how the prevailing hierarchi-
cal values of an androcentric culture mani-
fest themselves in scientific theories. A
study of the differences between this ap-
proach and the approach of Barbara
McCIntock, who had the ability to “dwell
patiently in the variety and complexity of
organisms,” (Keller, 1983: 207) might
convince students that the method by
which science is done is neither immu-
table nor objective.

A more realistic vision of science might

convince students that the position of
women in science is not inevitable but a
consequence of the dominant ideology of
science. It should also encourage them to
be more skeptical and analytical in their
approach to scientific information. The
goal of science educators should be to
give their students the tools of scientific
criticism, just as teachers of English hope
to give their students the tools of literary
criticism. Debates on scientific contro-
versies, critiques of scientific papers and
a study of the often misleading way in
which statistics are used are all methods
that might be used to encourage a critical
attitude toward science—a recognition
that science represents “simultaneously
true and contradictory multiple realities”
(Bleier) rather than one uncontestable re-
ality.

The existence of a more realistic, criti-
cal attitude toward science in the class-
room need not detract from the fact that in
large part, the science we have today
works. That is, it often very accurately
predicts laws that govern our natural world.
Though science often seems to be moti-
vated by the desire for power, domina-
tion, and maintenance of the status quo,
individual scientists are often motivated
by a desire to seek knowledge of the world
around us. This commitment to knowl-
edge of the world is one shared by scien-
tists and science teachers alike. What sci-
ence teachers need to recognize and to
teach is how these commitments “are
fueled and elaborated, and sometimes also
subverted, by the more parochial social,
political, and emotional commitments
(conscious or not) of particular individu-
als and groups.” (Keller, 1986: 11)

While students are unaware of the pol-
itical nature of scientific work, they also
hold negative and quite false images of
what scientists are like and how they carry
out scientific research. Research in sci-
ence ideally requires imagination, crea-
tivity and a passion for knowledge of the
way the world works. Much modern sci-
cientific research is done in teams of rela-
tively normal people working co-operat-
evally. The perception on the part of stu-
dents, however, is that scientists, particu-
larly physicists and chemists, are strange-
looking men who work in isolation in
lonely laboratories filled with weird and
dangerous equipment. It is not surprising
that most young women never give physi-
ics or chemistry a fair chance as a career goal.

There is an elegant, aesthetic aspect of science that is often completely lost in introductory courses in the physical sciences. These courses have a strong tendency to teach students to mimic the problem-solving technique of the instructor and completely ignore the beauty of the underlying concepts. In a study of very capable academics taking first year physics and chemistry courses the comment was made that these courses consisted of “too many scales and not enough music.” (Tobias) If science is to have wider appeal, science classrooms should be structured to reflect the co-operative, creative and aesthetic aspects of science.

Alternatives to the classroom hierarchy

The classroom is, for the students, the immediate, personal experience of the hierarchical, patriarchal school system and society. In dividing our students by gender, class, and academic ability we reproduce for them the gender and class hierarchies of our social system. At the top of the social system of the classroom is the teacher, in theory if not in practice, the holder of knowledge and power. The traditional classroom with teacher as authority and student as vessel reinforces pre-dominant social structures. The correspondence between the classroom hierarchy and the larger social hierarchy places the white, male, middle-class students above other students. If female students and racial minorities are to have equal voices in the classroom the hierarchical structure needs to be modified.

Science classrooms should be structured to provide an atmosphere of shared investigation as a more realistic reflection of the way in which scientific research is actually done. Though teachers obviously know more, even often know the probable results of the investigations, they should be eager to show that they do not know all the answers and that they can often learn from the students. The realization that some of the theories of science raise unanswerable, philosophical questions will help to temper the myth of the all-knowing scientist and with it the myth of the all-knowing science teacher. The teacher must share with the students the risk-taking process of theory formulation.

The focus of the teachers’ work should be to draw out or give birth to the knowledge that the students already possess. The teachers make contributions to the gaining of knowledge, a kind of labour coaching for the student, but “it is always clear that the baby is not theirs but the student’s.” (Belenky et al., 218) There is a need to reject the models based on power and domination both in science and in the classroom. In a system in which a model of connected teaching replaces the model of authoritative teaching, the science classroom has the potential to become a non-threatening place for all students.

The connected class provides a culture for growth—as Elbow says, a “yoghurt” class, as opposed to a “movie” class (in which students are spectators). The connected teacher tries to create groups in which members can nurture each other’s thought to maturity. Based on this model a science classroom becomes a place where “no one apologizes for uncertainty” because this is part of the process of “evolving thought” and theory formulation—a place of community rather than hierarchy. (qtd. in Belenky et al., 221)

The idea that women have particular “ways of knowing” that are in some ways in opposition to, or at least different from, masculine “ways of knowing” is very much a feminist standpoint position. (Harding) It raises the question of whether proponents of “women’s ways of knowing” are really advocating replacing one set of gender loyalties for another. The goal of feminist science educators should not be to replace teaching strategies based on men’s ways of knowing with ones based on women’s ways of knowing but rather to expand educators’ repertoire of teaching methods to include strategies that recognize both the influence of gender on learning styles and the ways in which the school system has neglected certain learning styles. This kind of expansion of the ways we allow students to come to scientific knowledge mirrors the expansion of the epistemological bases of scientific knowledge proposed by feminist critics of science. (Keller, 1986; Harding) Personal, political, and social factors play a role both in the forming of scientific knowledge and in the learning of that knowledge by students. Science educators, as well as scientists, need to recognize a variety of ways of knowing as valid approaches to gaining knowledge of nature.

Schools reproduce both the hierarchical, gendered structure of society and androcentric science. The forming of a different kind of science classroom requires a reconceptualization of the nature of scientific thought as well as a redefining of gender roles. In a society constructed by and for men this seems a daunting task. It begins with the recognition, on the part of both teachers and students, of the ways in which gender ideology has had an influence on both science and the school system.

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References


AMANDA EASON

After the Argument

One wants to hold the other at the precise moment the other leans away. I exaggerate. I mean this table is long and I sit frail and empty at the end.

The silent movie left me tight-mouthed.

See, I can be silent too.

A fountain is a river pumped backward against itself. So it is with voice.

The actress would not speak, I have exempted myself from the stage.

Speak, and wrap the night around your partner who will not give in.

He, on this small point remaining firm, refusing. And (perhaps mistakenly) I took this for a sign. Quietly slipping away eel-like into the silk of the night. Every noise is him coming to check: Let me crease the stones from your shoulders, smooth them to silk.

Instead: The crocuses in the windowbox have died, he said. And she noticed he was right, their petal-tips had rotted.

How long can I bear the cold, toes turned onto their knuckles and the deaf actress singing in my head.

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