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ABSTRACT

In some areas of the college curriculum, such as the humanities and social sciences, the process of transforming the curriculum to reflect women's studies has reached a fairly sophisticated level. Other disciplines, however, especially the sciences, have proposed greater dilemmas for feminist scholars. This paper presents a multidimensional framework for feminist curricular transformation, along with a view of what a feminist scientific environment would look like. The framework contains six domains of transformation and three levels of existing and future action taken to achieve a feminist curriculum. As an example of a scientific curriculum transformed to reflect feminist concerns, a research methods curriculum in psychology is outlined. A 152-item reference list is included, as are specific suggestions drawn from teaching experiences. (DB)

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On most college campuses across the country, a change is underway. Women and the issues of gender have become the subject of research, and the scholarly field of women's studies is coming into full bloom. In the humanities and social sciences, the process of transforming the college curriculum to reflect women's studies has reached a fairly sophisticated level (e.g., Golub, in press; Spanier, et al, 1984; Stimpson, 1980). Women's studies programs have coalesced into strong forces of change on campus, supporting faculty women and providing a stimulating intellectual experience for faculty and students (Walsh, 1986).

The Science Problem

When we turn our attention to other disciplines, however, the picture looks different. In methodological courses, mathematics, and the natural sciences, feminist scholars find themselves "outside the feminist mainstream", intellectually (Haraway, 1979) and personally (Buerk, Quina, Kroll, & Villars, note 1). In conversations with women scientists, I have consistently heard accounts of a struggle to integrate personal feminism and professional science: "My work is gender-free, so feminism is not relevant." Concerning curriculum, we ask, "Where can my feminism fit when I teach only prescribed science classes?" Thus scientists often become "spare-time feminists", without recognition or resolution of dual commitments.

One reason for this sense of dual commitments is that curricular transformation in women's studies has historically been concerned mainly with areas in which the primary content of research focuses on women or gender. In the scientific disciplines, scholarship on women or gender is rare; a "women's topic" in inorganic chemistry is not even imaginable to most feminist chemists. This approach implies that as long as science and math are gender-free, there can be no feminist science curriculum, and no feminist transformation. Either we locate gender issues in our science, or we leave science (and scientists) out of our feminist curricular effort.

Another historical problem is our tolerance for the cultural assumption that science and women don't mix (see Hein, 1981). While we have produced effective arguments against the outdated assumptions that women are not capable of doing math or science (e.g., Hyde, 1981; Sherman, 1983), we have not been as effective in getting those capable young women to pursue science. Lips (1984) found that young women believe they are capable of doing math and science, but they avoid these areas, because of the way math and science are presented. Kanarian (1983) longitudinally observed increasingly negative attitudes towards math among women (and significantly more positive male attitudes) in equally competent high school students. The extensive biases that turn women away from the culture of scientists have been documented by Hacker (1981) and Traweek (1984).

As of yet, women's studies hasn't found a way to help out the feminist scientist. However unintentionally, we have sent painful messages to women in science: either tough it out over there without us, or leave science and join us. We have led the way to a recognition of the patriarchal structure and practice of contemporary science (e.g., Bleier, 1984; Haraway, 1979). We understand that we cannot begin to move toward this reconstruction without feminist scientists (Fausto-Sterling, 1981b; Fee, 1983). Existing approaches, however, are inadequate. We have been narrow in our definitions of the problem, and negligent in our solutions. Continuing to leave a group of feminists out of the feminist discourse, as happens with many scientists, is politically and personally unacceptable.

Proposals for Resolution: Redefining Feminist Curriculum

The dilemmas posed by the sciences for women's studies can be guiding lights for an even broader view of curricular transformation. An enlarged view requires, first, that we redefine the term "feminist curriculum." In doing so, we must first redefine curricular transformation; and second, define multiple domains of the change process.

Toward Curricular Transformation: Feminist Goals

A curriculum should be defined by its goals, not its content. A feminist science will not be described by its topical scope, nor can we presume to prescribe methodologies or beliefs. These feminist goals are applicable to any underrepresented population, not just women, and to any scholarly pursuit:

(1) The scholarship available to students must be accurate and comprehensive. Gender bias and stereotypes have no place; wherever gender is relevant, research, theory, and applications

must be based on women's lives as well as the lives of men.

(2) Women and men must have equal access to the curriculum we offer. Women students must not be treated differently from men, including discouragement from enrolling in science courses or discriminatory treatment while taking those courses.

(3) Women must have an equal role in the creation of the future, so that their visions stand alongside -- or better yet, are integrated with -- views created by men. Genuine equality is essential to the attainment of this goal; without a corpus of feminist men and women creating science, we will see little in the way of transformation of the scientific structure or content regardless of numbers.

The Science Environment: Frameworks for Transformation

We can also suggests an expanded list of the domains in which transformation can take place. Previous approaches to curriculum transformation have concentrated on the primary content of the discipline, introducing gender issues and the experiences of women and working towards curriculum integration. These perspectives on transformation are important, but for a gender-resistant curriculum like science, a unidimensional content approach is not sufficiently powerful. To engage the science curriculum fully into the process of feminist change, we must expand beyond primary content, widening our appreciation of the different domains in which feminist transformations are possible.

Indeed, we must examine the *environment* of doing, sharing, and teaching science. A multidimensional framework for the transformation of the curriculum provides a structured view of a feminist scientific environment. Along with an expanded set of six domains of transformation, I have ventured to analyze levels of existing and future action taken to achieve a feminist curriculum. The resulting multidimensional framework for feminist curricular transformation is presented in Table 1.

Table 1

Multidimensional Plan for Feminist Curricular Transformation

CURRICULAR DOMAIN	LEVELS OF ACTION Level 0	Level I	Level II	Level III
Primary content	Based on male	Discovering Women's Studies	Female experience as basis	Human experience Integrated
Secondary content	Masculine base	Examples from Women	Examples that teach	Increasing Perspective
Modes of Analysis	Classical experiment	Identify bias in research	Expanded range of analyses	Comprehensive research model
Pedagogy	Quantitative -dualistic	Effective Instruction	Revised pedagogical goals	Epistemological transformation
Professional Model	Male - dominated	Female presence, sex-blind	Feminist mentor and model	Feminist science environment
Theory of Science	Rational, sci. method	Demonstrating value-laden	Alternative scientific modes, views	FUTURE World view Meta-paradigm shift

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Curricular Domains

My vision of curricular transformation is a process framework within which any teacher - scholar could move towards feminist goals, in any discipline. Reviews of contemporary feminist work have offered pieces of this framework, which fall into six curricular domains:

(1) The primary content of the course can be changed to reflect new scholarship on women or gender issues;

(2) The secondary, or incidental content of the course, such as illustrations and examples, can be made gender-fair;

(3) The modes of analysis developed in the course can be expanded to reflect a wider range of scientific values;

(4) The teaching can observe a feminist pedagogy that promotes effective learning for all students;

(5) The personal and professional roles of the feminist teacher can serve as models for students;

(6) The world view, found in assumptions underlying the curriculum and discipline, can be brought to the explicit level and analyzed, offering alternative approaches to the definition of science and its uses.

Not all of these domains may be changed immediately in every discipline. For each discipline and each topic there are "best points" to begin transformation, and some curricula are labile in more domains than others. The "rule of thumb" is simple: move the domains that are the most moveable first, as far as they can be moved.

Levels of action

At the same time, we must be able to evaluate the progress of our transformation, from prefeminist to fully feminist scientific environment. McIntosh (1983) and Schuster and VanDyne (1984) have offered models for phases of curriculum transformation for primary content, moving from "womanless" to a gender-integrated curriculum. The present approach is not as fully developed, but will adopt their perspectives on the direction of feminist progression. Since I am concerned with levels of *action*, the inactive, prefeminist level is "level zero", otherwise known as the traditional curriculum. In general, *Action Level I* occurs when gender biases are recognized and women are located in the science; *Action Level II* introduces and values alternatives to traditional scientific approaches; and *Action Level III* integrates and transforms the best of traditional and nontraditional approaches into a feminist scientific environment.

These six domains and three levels of action are brought together as a framework for implementing feminist curricular transformation. The assumptions behind this approach arise from within the existing curricular reality, pragmatically tied to the developmental level of professions that only recently allowed women even to teach scientific or quantitative courses. Furthermore, this approach assumes no institutional support for disciplinary transformations, again a reality for most feminist scientists. It should be viewed as an action plan in which anyone can participate.

However prototypic, this two-dimensional framework does hold promise for a feminist science. In some disciplines such as psychology, the new content has already affected the methods we use, while new modes of analysis employed by feminists are producing a new body of knowledge for the next generation of scientists. Perhaps most importantly, the ways we model and teach have influenced students' views of what science is or can be, and thus have begun to shape a new professional and scientific future.

Personal Illustrations: The Experimental Psychology Course

In this paper I will select many examples from the research methods curriculum in psychology, my own course. Specific suggestions from my own teaching are found in Appendix A. For the past century, we have taught students that scientists use research methods to guarantee that we are objective, and with the right technological and statistical machinations we can approximate the truth. Yet researchers have always both reflected and directed the biases of the theoretical and social environment (e.g., Cook, 1984; Gould, 1981; Mackenzie, 1984; Scarr, 1985; Wittig, 1985). In particular, the ability to support opposing theoretical views with the same technology illustrates the need for more than a content-based transformation in psychology.

As I will demonstrate, the research methods course provides a powerful arena for dealing with gender bias and introducing a feminist environment within each domain of our multidimensional framework. Since nearly all students in the U.S. must take a statistics and/or research methods course for a major in psychology, education, nursing, business, economics, engineering, and the natural sciences, these courses hold a unique place in the formative experience of many college students. Many of us developed our simplest and most dualistic notions about scientific truth, and ideas like the dominance of statistical significance over real-world significance, in methods courses. They are also the courses that too many of us remember with little pleasure, and too many newcomers face with anticipatory dread.

As we move into specific action plans, I should reassure readers about some sacred assumptions in science. I am a researcher by trade and by heart, and I believe science can and should be of tremendous interest and value to students. So here I make some important premises. First, I am *not* going to argue that in transforming our science we should lose our concern for objectivity or our empiricism, or accept simplistic solutions to calls for relevance. The goals of science have been ably argued in the literature (e.g., Fee, 1983; Keller, 1985). Second, I *do* believe that much in the traditional science curriculum is valuable, including formal writing style, statistical techniques, and hands-on research. The environment, rather than the science, is most frequently flawed. And third, I will *not* assume that women need special help to do science. In contrast, I will argue that traditional scientific curricula and the environments they create benefit neither women nor men, nor science.

Feminist Transformations in Action

Feminist Primary Content

As discussed earlier, most efforts in feminist curricular transformation have concentrated on the topics of lectures and the incorporation of women's issues into the mainstream disciplinary content. Scholarship on women or gender issues should be incorporated whenever relevant to content. McIntosh (1983) has described increasingly sophisticated phases of incorporating feminist content into the curriculum, and I refer readers to her analysis. In the sciences and mathematics, however, enthusiasm for primary content revisions is dampened by the lack of gender relevance of topics. Thus the teacher needs to be particularly vigilant and creative in order to introduce gender issues.

Areas in which feminist research is available include the biology of gender (Fausto-Sterling, 1985), and of women (Sloane, 1980); feminist economics (reviewed by Ferber & Teiman, 1981); the technology of women's health (e.g., Arditti, Klein, & Minden, 1984; Dreifus, 1978); feminist social psychology (Lott, 1985). Historically, the treatment of women and women's concerns by popular science (Newman, 1985) and by the medical profession (Ehrenreich & English, 1978) are invaluable teaching resources for raising consciousness about the feminist scientific goals. Issues of technology correspondent to goals of many feminists are reviewed in Rothschild (1983), including ecology, the nuclear arms race, and the domination of nature.

Feminist Secondary Content

We may be expected to teach a designated set of methods, but the examples and projects illustrating those methods are usually ours to select. Research shows that secondary content is important; students have surprisingly good memory for even the pictures in textbooks (Goldstein, Bailis, and Chance, 1983), and those pictures are surprisingly sexist and racist (Quina, 1981). Performance on test items is affected by the gender of actors or content in the question (Brown, 1980; Crawford & English, 1981). The fact that males figure most prominently in secondary content (e.g., Thorne, Kramarae, & Henley, 1983) compounds concern about gender balance.

Secondary content transformations demonstrate our three levels of action in several ways:

Action Level I: Gender-fair illustrations

The content must not be offensive to either gender, and the material must deal with areas of life that are relatively familiar to as many students as possible. Examples like the probability of picking up a blonde in a crowded bar, or setting point spreads in the Superbowl, are unacceptable. Physics courses are heavily vested in examples of bombs and missiles (Keller, note 2), and a popular televised course fires a dart into a stuffed monkey to demonstrate F=ma. Math is no better: for the past decade, high school students in Rhode Island learned the metric system from an NEA-sponsored pamphlet, *Metrification American Style*, covered by a bikini-clad but properly measured Miss Metric.

Action Level II: Examples that teach

Students are more motivated when they are given a problem or project that is personally meaningful. Recognizing this, instructors of math, psychology, genetics and other courses often seek out realistic studies or examples. Illustrative examples and project assignments can be based on feminist scholarship, helping students to learn something new along the way. Three kinds of feminist examples that teach are: 1) research on a "women's studies" topic, such as the relationship between physical and sexual abuse (e.g., Gelles, 1979); 2) research liberating us from stereotypes, for example of women's mental health (Baruch, Barnett, & Rivers, 1984; Chesler, 1973), or debunking claims of intellectual differences between the sexes (Caplan, McPherson, & Tobin, 1985; Lowe & Hubbard, 1983; Jacklin, 1979); and 3) research published by women, regardless of content area, in order to expand students' conceptions of women's contributions. Teaching examples for psychology, including suggested class activities, are described in Golub (1986, in press), including my own description of gender-integrated topics and activities for the experimental psychology course. Frankenstein (1983) offers real-world teaching examples for mathematics.

Action Level III: Expanding awareness and horizons

Most courses -- indeed, most teachers -- are restricted in scope of human diversity. We are shamefully lacking in interdisciplinary, geopolitical and multiethnic perspective. New research, other than that of the instructor's own lab, may not be added into well-worn lecture notes, much less into textbooks. As a result, students often find courses like experimental psychology outdated and dull. Instead of restricting their perspectives, we could expand the horizons of psychology and students' interests by serving a new, more varied menu, including: 1) an historical background to contemporary studies (e.g., in mathematics, see Dantzig, 1954; in physics, see McElheny, 1986; in psychology, see Shields, 1975); 2) new theories developed from gender-fair methods (e.g., Gilligan, 1982; Horner, 1970); 3) new research areas opened up by feminist scholars (e.g., peace psychology, in Brock-Utne, 1985); 4) multi- disciplinary views into research problems; and 5) a positive view of human diversity, including cross-cultural and multiethnic perspectives for a frank look at the egocentrism of our science (Alvarez, Chandler, Nicola-McLaughlin, Schweickart, & Simpson, note 3).

Feminist Modes of Analysis

Textbooks and traditions have dictated a limited set of analytical techniques for most science courses, suitably homogenized to fit simple truths and often gender-biased value systems. In experimental psychology, there is only one valued form of scientific process, the scientific method, and one consistently trusted way to test out theory, the traditional factorial experiment (for historical perspective, see Danziger, 1985). I propose an expansion and transformation of the modes of analysis we offer our students, on three levels of action:

Action Level I: Research critiques

We can help students recognize evidence of gender and other forms of bias, and provide techniques for reducing such flaws in their own work. Feminist critiques of gender bias in experimental psychology (e.g., McHugh, Koeske, & Frieze, 1983; Wallston, 1981; Weisstein, 1971) can be incorporated with teaching the positive side of experimenter, subject, and design controls (e.g., Parlee, (1981). (A balanced view is essential, lest you find you have created a group of hypercritical cynics!)

Action Level II: Varieties of research

One of the most significant advances of the new feminist scholarship, especially in psychology, has been the utilization of a variety of analytic approaches to research problems. Reinharz (1984) has demonstrated the value of qualitative research and experiential methods. At the other end of the quantitative spectrum, sophisticated new statistical techniques such as metaanalysis allow us to evaluate the magnitude and meaningfulness of reported gender differences (Eagly, 1978; Hyde, 1981; Rossi, 1983); and effective applications of multivariate analyses can allow us to examine relative contributions to such differences (e.g., Kanarian, 1983). A special issue of *The Journal of Social Issues* reviews some underutilized methodologies for feminist research (Stewart & Platt, 1983).

Action Level III: Understanding the meaning of research

The terminology we provide for students has a powerful impact on the meaning they attribute to research. Thanks in no small part to our teaching, students lose (or never gain) sight of the difference between statistical and real-world significance, and begin to overinterpret their results ("I've found The Cause!", I remember myself saying back then). Concepts like statistical power are often slighted or omitted altogether, while estimates of practical significance are barely mentioned (Rossi, 1984). We need to provide better guidelines for understanding research findings: what results mean, and what they do not mean.

Particularly helpful are comparisons of studies with differing findings on a single problem, of studies with different theoretical and methodological approaches to a problem area, and of the outcomes of different statistical analyses within a given research report. Some examples from my own course are provided in Appendix A.

The relationship of laboratory findings to real-world observations is another oft-neglected perspective. It has been argued that *ecological validity* should be an ongoing issue for every research methods course, not an obligatory footnote to the last lecture (Bronfenbrenner, 1977). A warning: do not confuse ecological validity with contemporary "ecological psychology" or ecology, both of which have shown greater concern with computer-generated mathematical models than with real behavior (Neisser, interviewed in Shields, 1984; Simberloff, 1984). In mathematics, Brown (1984) has argued for an "applied math" of sorts, but not the usual engineering or computer applications. Rather, he suggests humanistic applications to enrich personal relativity.

Feminist Pedagogy

Among the most exciting new applications of feminism is the concept of feminist pedagogy. Part of the "macho" scientist role is that "a good researcher doesn't need to teach"; teaching and students are seen as a bothersome detour from self-serving goals (Fausto-Sterling, 1981a). A review of current practices in the traditional research methods classroom would reveal the following assumptions: (1) Methodology is a dualistic, quantitative subject. (2) Advanced study is for an elite few, so all students should be taught as if they will become full-time academic researchers, allowing the rigor of the course to "weed out" those who should "look for something else, like social work" (a quote from a level-zero colleague). Finally, (3) since we are teaching a "rational" science, and since human beings aren't capable of rationality without our methods courses, anything smacking of experience or "emotion" is not permissible.

Feminist pedagogy rejects these assumptions. The various definitions and approaches feminist pedagogists have described share an important element in common: teach to the strengths our students bring to the classroom. This demands from the outset that we respect all students, and that we care about the teaching role. Levels of action towards a feminist pedagogy include:

Action Level I: Pedagogical Effectiveness and Fairness

I have found it easier to become a good teacher than to remain (or become) a bad one. Instructional development should be a priority of all who are responsible for communicating science, even if that means seeking out a trusted colleague who is a good teacher who will come to your classes and help out. For most disciplines, a range of useful materials is available from the professional association, as well as books on teaching tips (Kozma, Belle, & Williams, 1978; McKeachie, 1986; Milton & Associates 1978). On a daily basis, communicating our science through the classroom in an effective manner, including being organized and prepared, clear and fair, should be placed high on our list of personal and professional priorities.

Classroom interactions must also be rid of gender biases. Sadker and Sadker (1985) have demonstrated the kinds of subtle student-teacher interactions that discourage females in math classes. Other discussions of gender-biased pedagogy can be found in Hall and Sandler (1982, 1984), and should be of concern to each of us.

Action Level II: Instructional attitudes and goals

Goals for students in the feminist environment may differ dramatically from the traditional instructional objectives of the science classroom (see Harrison, 1982). In fact, the classroom goals expressed by feminist pedagogies are in close synchrony with the reality of contemporary students' needs and experiences. For example, one major pedagogical objective apparent in experimental psychology is solving equations and plugging data into formulae. Yet these skills are only one niche in the domain of psychology, or any science; in isolation they are often useless. Geophysicist Davies (1983) has complained that the two greatest problems he encounters in his students are their lack of problem solving skills and their inability to explain their quantitative work to others, to communicate their ideas and results.

Another contemporary reality is that education is not for the "elite", as teacher or student. Increases in the proportion and diversity of young people attending college, along with the decline in numbers of bodies to fill our courses, have forced even the most elitist academic to consider ways to attract more students; but many have yet to connect that fiscal concern with the ethical position of their role in the classroom. In reality, very few of our students, even the brightest and the best, are likely to be doing academic research ten years from now, much less on our topics or with our methods.

The exclusivity of the traditional methods course has come under a general attack on the goals of the psychology curriculum. Variations from traditional goals are offered in a special issue of *Teaching of Psychology*, notably the essay by Costin (1982), who lists as priorities for students: a sense of history, the ability to communicate, and quantitative thinking skills. *For the Learning of Mathematics* contains good resource materials for goal-setting in quantitative teaching, notably Bouvier (1985) and D'Ambrosia (1985).

In revising goals to include full participation of as many students as possible in science, pedagogical considerations must include the following:

1) *Is this a "weed-out" course, or do I want all my students to learn something from me?* Harrison (1982) reflects on these conflicting priorities among science teachers. In the former case, emphasis is on differentiation between individuals, usually in terms of discrete mathematical skills and usually skills learned prior to the methods course experience. In the latter case, emphasis is on effective learning, for which a mastery approach can readily be adapted to any course. For example, there is no reason to have students churn out five papers if they have not been allowed feedback on the first four! (See Appendix A for my alternatives.) Ward (1984) offers a novel mastery approach to

teaching statistics; Yoder (1979) offers organizational plans for a research lab course that can be helpful. Byers (1984) discusses ways to bring mastery learning into mathematics education.

Other simple pedagogical truisms such as setting clear objectives and devoting practice time to skills are frequently absent from methods courses. It should make us ponder: why don't psychologists utilize good instructional psychology, but more surprisingly, why don't we think we should?!

2) *Is the subject rote mathematics or problem solving with a quantitative toolkit?* Should the long-term goals be memorizing formulas and their derivations, or the utilization of statistical operations in quantitative and verbal evaluations of research? My work agrees with Jacobs (1980): post-statistics students have consistently demonstrated that the latter type of statistical training lasts longer and is more useful. Similar arguments can be found in geophysicis (Davies, 1983), economics (Leontief, 1982), and ecology (Simberloff, 1984). Lessons about the need to strengthen statistical reasoning can be drawn from cognitive psychology (e.g., Nisbett, Krantz, Jepson, & Kunda, 1983; Tversky & Kahneman, 1983); lessons about the danger of mathematization of a field can be learned from Hacker's (1983) historical analysis of class and gender exclusions from engineering. This is not an argument for devaluation of quantitative skills, but an argument for the approach we have called "analytical thinking skills" (Quina & Kulberg, 1983; in statistics, see Jacobs, 1980). This thinking skills approach, a current topic in mathematics (Buerk, 1985), has applications in research methods (in Appendix A).

3) *Should we emphasize the content or the process of research?* This issue took form for me when my students kept asking, "Why do I have to take this course?" After considerable soul- and syllabus-searching, I rephrased this question as, "Am I training a few future academic research psychologists, or can I help a larger group of people develop some valuable skills for whatever they choose to become?" In this "information age", with content and methods changing rapidly, we need to prepare for what Makosky (1985) calls "self-education". Bossley, O'Neill, Parsons, and Lockwood (1980) have described a problem-solving approach for teaching statistics; Buerk (1985) and Brown (1984) have applied a problem-generating approach to mathematics education. This process perspective, an integral base for the analytical thinking skills approach, allows students to transcend the ever-changing content of a growing scientific field, as well as to transfer the skills to arenas outside psychology.

Level III: Epistemological Transformations

Creating an effective learning environment for students involves more than just being entertaining or giving interesting problems to solve. Several researchers have found different "thinking styles" or cognitive perspectives from which students approach their material. In some of these epistemologies, there is evidence that women and men in general may respond with different preferred styles (e.g., Belenky, Clinchy, Goldberger, & Tarule, 1985; Gilligan, 1982; Miller, 1976). In each case, traditional pedagogy utilizes or teaches to the patriarchal response style, resulting in discomfort, if not discrimination, in the education of those who learn best in a different style. As I envision it, feminist pedagogy attempts to move students out of the singular traditional intellectual route and into a more balanced epistemological environment. Part of the justification is the full inclusion of women. But even more compelling is the argument that incorporation of divergent styles into the learning environment will benefit both men and women (e.g., Buerk, 1985; White, 1976): first, by overcoming or even avoiding the socially magnified differentiation of thinking styles now observed; and second, by giving each participant in the learning process a range of problem solving options. Some of these epistemological options will be discussed in turn:

1) *Dualistic versus Relativistic Thinking.*-- Perry (1970) has described a developmental pattern in college males, from a dualistic (right-wrong, black-white) approach to intellectual resources (including the teacher), to a more relativistic style. Using Perry's developmental scheme, Donovan, et al (1984) have demonstrated a relationship between intellectual development and science learning. Quina, Kanarian and Stang (1982) have suggested that adult women students in particular prefer a relativistic classroom style, an observation borne out by Buerk's (1982) work with math-avoidant women. Asking a dualist for more complex thinking may be tougher than ordinary teaching, but it can be argued that challenging the existing mode is worthwhile for the overall developmental progress of the classroom. Specific developmental-stage teaching tips have been offered for the general teaching situation by Kneffelcamp (1974), Maher and Dunn

(1984), and Copes (1982), as well as for math (Bouvier, 1985; Buerk, 1985), and engineering (Fitch & Culver, 1984).

2) Separate versus Connected Knowing.-- Gilligan (1982) has talked of the "different voice" used by adult women in moral decision making. Clinchy, Belenky, Goldberger, and Tarule (1985) have refined a description of connected thinking in their developmental studies of adult women's reasoning. Buerk (1985) has found that mathematicians use a connected form of thinking in their own research, using Gilligan's (1982) words: intuitive, contextual, narrative, and so forth. Clinchy, et al's (1985) connected education includes respect for the learner, a link to personal experience or reality, and freedom from the "tyranny of expectation." Freire (1970) develops similar lines in his educational models for change among the oppressed. Hettich (1980) offers strategies within psychology that mesh with a connected approach.

3) Devaluation versus Appreciation of Life Experiences and Diversity.-- At the simplest level, drawing upon the existing knowledge base of students increases the personal meaning of even an "objective" course like statistics. Reviewing the popular press for faulty methodology, or applying scientific tools to everyday concepts (like having students operationally define the hypothesis "success breeds success"), have been effective personalized teaching tools for even the most impersonal concepts.

Life experience contributes to behavior in the classroom in more ways than mere volume of facts. Drawing upon the work of adult developmentalists (e.g., Perry, Clinchy et al, described above), our own research on ego development in adult women in school (Quina, Kanarian, & Stang, 1982) has demonstrated a strong link between successful coping with stressful life events and relativistic thinking style. Salner (1985) challenges the traditional graduate education of women from similar models. The intellectual skills older students bring into the classroom readily adapt to learning research methodology when relativistic thinking is encouraged. However, a traditional dualistic approach can be both confusing and personally devaluing to the relativistic student. That question of "But why do you use formula A instead of B?" may not indicate a lack of understanding of what you have been teaching, but an attempt to move to a deeper level!

Finally, my feminist pedagogy gives legitimacy and respect to human emotion and experience within science. The personal side of experiences, such as the qualitative reaction to rape, are included as legitimate data for the scientific hopper. Instead of denying the existence or role of personal experience in planning and developing research ideas (and it is there, even for the men, as described in Golden, 1976), we should appreciate and even explore the interrelationship between experiential and empirical paths toward understanding (see Martin, 1985a).

Feminist Professional Models

Many of us have had to survive in academic environments devoid of women as teachers, mentors, or colleagues, and we know it isn't professionally or personally healthy. Women have also been noticeably absent from our past, at least according to standard histories and biographies of science. In some gender-underrepresented fields, we have a feminist impact merely by being there. However, there is much more that we can do:

Action Level I: The Female Presence

The first level of effort must be to increase the number of women in science. Rapid relative gains in headcounts of women have been documented in engineering (Fields, 1984), math (Schafer & Gray, 1981), and in technology (Pfafflin, 1984); yet in each case the authors have demonstrated significant barriers which keep the absolute gains still very small. As one moves through the "hierarchy of the sciences", from social to biological to "natural" sciences like physics, and from applied to theoretical research, Hacker (1981) asserts that the culture of doing science becomes even less supportive of women's presence, and the numbers of women who stay bear her assertion out. Strategies to increase women's interest in science have been offered by Branscomb (1979), the American Association for the Advancement of Science (1982), and other groups whose resources are reviewed by Hall and Sandler (1981). As argued earlier, however, these strategies will not work as long as the scientific environment is not welcoming.

Same-sex advisors and mentors have clearly been shown to be important to young women (Goldstein, 1979; Hall & Sandler, 1983;

Perun, 1982). Efforts to encourage and retain large numbers of women in science cannot fully succeed without women to meet and support them. This amounts to a mandate to promote the academic and professional careers of our young women students. When women (note the plural!) are not present, every effort should be made to bring women in as guest speakers, consultants, and especially as new faculty members. In the classroom, regardless of teacher gender, research by women should be discussed alongside that by men, with clear attributions to the authors.

We also need to bring forth a history of our science that includes our foremothers. Learning more about early women in research is fascinating for mature scientists; but giving a female heritage and tradition to our young students is, from my experience, a direct invitation to join and to stay. Some good historical resources are now available. In psychology, O'Connell & Russo (1983) and Furumoto and Scarborough (1986) have begun to bring back the historical presence of women. Resources for integrating the history of women into the psychology curriculum are offered in Quina (1986). Women scientists and mathematicians can be located in Lerner (1979) and Rossiter (1982).

Action Level II: The Feminist Model

Students don't just learn *about* the women in their science, they learn *from* us. For the woman teacher, this may mean providing students a view into her life as well as her research; advising beyond the coursework; and nurturance (and mentoring) as they develop their own niche in the society of the science. It never fails to astound me when a bright woman student says to me, "You're the first teacher who has ever told me I am smart". Of course, too much self-disclosure for the academic woman is risky. Rose (1986, in press) offers first-person discussions of models, including issues like self-disclosure, and useful suggestions for professional women, including two of my own papers for the beginning teacher. Hall and Sandler (1983) offer more general resources.

Students need to be socialized into the profession (Katz & Hartnett, 1976), and women often need a different socialization from men, because the profession will not be as accepting or forgiving (Bronstein, in press; Cole, 1981; Graham, 1978; Sutherland, 1978). The unapproachable woman professor only confirms students' worst stereotypes about female scientists, and those who care about their working environment are likely to take their talents to another mentor or another major.

In addition to our own roles, students can learn from the lives and work of women scientists. Fausto-Sterling and English (1985) taught an exciting seminar on women and minorities in science at Brown University, which drew an impressive group of young minority and nonminority science hopefuls together. Their work resulted in a publication that would convince even the most skeptic about the value of integrating personal and scientific life themes in studying the history of women. They truly learned from their models.

Action Level III: The Feminist Science Social Environment

The recognition that some scientists have a different way of doing science, a way that integrates into a scientific model the epistemological styles of connectedness and relativism, is promising evidence for another level of feminist professional leadership. As Bruer (1983) argues, "studying only the survivors will not answer some key questions." Lemkau's (1983) demonstration of atypicality in women in male-dominated professions lends credence to this assertion. The "feeling for the organism" science done by McClintock (Keller, 1983), the feminist research group described by Reinharz (1984), and Kneffelcamp's (1985) description of the inclusive learning environment, offer us a starting point for creating a student environment that nurtures epistemologically and personally balanced participation. Science should not take place in a societal vaccuum; humanism and science would differ only in their specific technologies. This is the scientific environment whose creators we could be creating.

Feminist Theory of Science

A number of critics have convincingly argued that even our most fundamental assumptions about science, that it is value-free, objective, and rational, are incorrect. The three levels of feminist transformation are only just beginning, but they could imply a dramatic future paradigmatic shift. For the teacher, these levels also represent the extent to which this evolving world view is shared in the classroom.

Action Level I: The Feminist Critique of Scientific Theory

Until recent years, our faith in science as "amoral" and apolitical (Giorgi, 1970) was unshakable, even in psychology. Currently in vogue, however, are "discoveries" of intrusions of personal or political (or even funding source) values into research and its applications (in psychology, see Gergen, 1985; Howard, 1985; Kimble, 1984; in biochemistry, see Marshall, 1985). But among the first (and still the best) voices of criticism were feminist scientists. In 1910, psychologist Helen Thomson Wooley called her colleagues to task for "logic martyred in the cause of prejudice, and even sentimental rot and drivel"; Grady (1981), Unger (1983), and Wittig (1985) have more recently published excellent feminist critiques. In a broader scope, Longino and Doell (1983), Lowe and Hubbard (1983), and Keller (1985) have documented the irrationality of so-called scientific rationality; and Tirman (1984) has called to our attention the increasingly political relationship between the military and scientific research.

Public policy implications of research are also under scrutiny, for good reason. Psychologists are beginning to recognize the relationship between their science and their political/social world, and consciously to promote those connections (e.g., Russo & Denmark, 1984). Scientists are not divorced from the uses of their knowledge, nor is technology value-free (Rothchild, 1983; Arditti, et al, 1984; and for a chilling report on the "Star Warriors", see Broad, 1985).

Attacks on our current theory of science, a theory appealingly simple and successful, are not easy for young, dualistic and naive students. Teaching that our science is not perfect may be difficult; we all want to believe in it. Furthermore, when we merely introduce critiques alongside the "real science", we seem to give students only a "true-false" option. They can either reject the feminist critique, or reject the science. The teacher introducing the critique needs to provide a blend that is tolerable to the average student, or an ebb-and-flow model. Hoffnung (1986) and Unger (1986, in press) offer useful approaches for introducing critiques of world views.

Action Level II: Alternative Scientific World Views

It is extremely difficult to envision an alternative to the world view assumed by traditional science, because we are all so steeped in those assumptions. However, most feminist philosophers of science concur that a feminist science would start with a different set of experiences and assumptions (Keller, 1985; Overfield, 1981). One option might be a subjective approach; but generally that is rejected in favor of using women's life experiences and concerns as a starting point for revising the scientific agenda. These new views are still being formulated, and they potentially pose a great leap from traditional science. If we can avoid issues like "but science the old way is fundamentally good, it just needs better scientists", or "there is only one empirical science", we may develop a rich set of alternative world views. Taking the first steps at this level of transformation, however, is difficult for both the pioneers developing views without historical foreparents and for the students trying to comprehend these new views.

Action Level III: The Future Feminist World View

It is clear that our current level of thinking, although exciting and promising, must yet undergo dramatic shifts before we arrive at a paradigm shift in world view. In a sense, what we may hope to experience is a *metaparadigmatic shift*: while the technology and subject matter of science may not be radically altered, there will be new assumptions, attitudes, environments, and politics. Although some have called for these transformations (e.g., Bales, 1985; McDonald, 1982), we have not evolved nearly far enough to begin this work. Predicting the scientific future is beyond the scope of this paper (or my resources), but a few directions of thought stretched by the imagination might include:

(1) Subjective and objective no longer distinct polar qualities, but blended aspects of one perspective;

(2) Rational emotional epistemological models (e.g., Martin, 1985b);

(3) Nonlinear, discontinuous models of growth and change, of predictability;

(4) Science open to the public in an understandable form, as a normal obligation of the scientist (who, of course, will be expected to, and able to, communicate effectively); and a public who are able and willing to take the responsibility of scrutiny without censorship.

(5) Clearly exposed political values, resource bases, and potential uses of the research.

(6) A supportive, humanistic environment in which the process of science takes place.

Conclusion

The multidimensional action plan proposed here is one route to feminist curricular transformation in disciplines previously resistant to feminist impact. I have not provided details of many of the studies I cite, because they are intended as resources. I chose this approach because I hope that readers will view their curricular options in more general terms. What psychologists have done may not impact the content of physics or chemistry; but the process I have developed within the psychology context can be useful in other disciplines.

In closing, I would like to admit that my favorite assaults on sexist science take place in the classroom. Perhaps it is the reward of positive feedback; because generations move so fast in academic you can see immediate change. I have seen former students successfully counter bias in subsequent classrooms with the tactics they learned in my class; I have watched them discover new lines of interest which have led to innovative careers and personal growth. This past year I saw the generational impact most clearly when a former student, now a teacher, told me that he uses feminist and anti-racist examples in his own research methods class, because "they were the ones that were most clearly laid out for me, and the best documented, so I feel most confident passing them on." He added, "last week an undergraduate from a previous semester came to my office for advice on her senior research project, because she remembered my warnings about bias."

Reference Notes

1. Buerk, D., Quina, K., Kroll, J., & Villars, T. *Discussion of dilemmas facing women in science.* Mellon Seminar, Transforming the Science Curriculum, Wellesley College, March 1985.

2. Keller, E.F. *Discussion of strategies for changing science.* Northeastern University Lecture Series, May 1985.

3. Alvarez, C., Chandler, Z., Nicola-McLaughlin, A., Schweickart, P., & Simpson, G. *Discussion of third world women, science and technology.* Mellon Seminar, Transforming the Science Curriculum, Wellesley College, April 1985.

References

American Association for the Advancement of Science (1982). "Science: Woman's Work". *Science*, 217, 44.

Arditti, R., Klein, R.D., & Minde, S. (1984). *Test-tube women: What future for motherhood?* Boston: Pandora Press.

Bales, J. (1985). Graduates lack policy exposure. *APA Monitor*, December, 30. [Report of American Psychological Association meetings].

Baruch, G., Barnett, R., & Rivers, C. (1984). *Lifeprints: New patterns of love and work for today's women.* New York: New American Library.

Belenky, M.F., Clinchy, B.M., Goldberger, N., & Tarule, J.M. (1985). Epistemological development and the politics of family talk. *Journal of Education*, 167(3), 9-27.

Bleier, R. (1984). *Science and Gender: A critique of biology and its theories on women.* Elmsford, NY: Pergammon Press.

Bossley, M., O'Neill, G., Parsons, C., & Lockwood, J. (1980). Teaching implications of statistical procedures used in current research. *Teaching of Psychology*, 7(2), 107-108.

Bouvier, A. (1985). On strategies for teaching. *For the Learning of Mathematics.* 5(1), 2-11.

Branscombe, L.W. (1979). Women in Science. *Science*, 205, 751.

Broad, W. (1985). *Star Warriors.* New York: Simon & Schuster.

Brock-Utne, B. (1985). *Educating for Peace: A feminist perspective.* Elmsford, NY: Pergammon Press.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist*, 32, 513-531.

Bronstein, P., Black, L., Pfennig, J., & White, A. (1986). Stepping onto the academic ladder: How are women doing? *In* Gutek, B., & Larwood, L. (Eds), *Pathways to women's career development.* Beverly Hills, CA: Sage Books, in press.

Brown, F.G. (1980). Sex bias in achievement test items: Do they have any effect on performance? *Teaching of Psychology*, 7(1), 24-26.

Brown, S.I. (1984). The logic of problem generation: From morality and solving to de-posing and rebellion. *For the Learning of Mathematics*, 4(1), 9-20.

Bruer, J.M., Jr. (1983). Women in science: Lack of full participation. *Science*, 221, 1340.

Buerk, D. (1982). An experience with some able women who avoid mathematics. *For the Learning of Mathematics*, 3(2), 19-24.

Buerk, D. (1985). The voices of women making meaning in mathematics. *Journal of Education*, 167(3), 59-70.

Byers, B. (1984). Dilemmas in teaching and learning mathematics. *For the Learning of Mathematics*, 4(1), 35-39.

Caplan, P.J., MacPherson, G.M., & Tobin, P. (1985) Do sex-related differences in spatial abilities exist? A multilevel critique with new data. *American Psychologist*, 40, 786-799.

Chesler, P. (1973). *Women and Madness.* New York: Avon.

Clinchy, B.M., Belenky, M.F., Goldberger, N., & Tarule, J.M. (1985). Connected education for women. *Journal of Education,* 167(3), 28-45.
Cole, J.R. (1981). Women in science. *American Scientist,* 69(4), 385-391.
Cook, S.W. (1984). The 1954 social science statement and school desegregation: A reply to Gerard. *American Psychologist,* 39(8), 819-832.
Copes, L. (1982). The Perry development scheme: A metaphor for learning and teaching mathematics. *For the Learning of Mathematics,* 3(1), 38-44.
Costin, F. (1982). Some thoughts on general education and the teaching of undergraduate psychology. *Teaching of Psychology,* 9(1), 26-28. [See other articles same issue].
Crawford, M., & English, L. (1981). Sex differences in recall as a function of "generic" vs. female-inclusive contexts. Paper presented at the 52nd Annual Meeting, Eastern Psychological Association, New York.
D'Ambrosio, U. (1985). Ethnomathematics and its place in the history and pedagogy of mathematics. *For the Learning of Mathematics,* 5(1), 44-48.
Dantzig, T. (1954). *Number: The language of science (4th ed.).* New York: The Free Press.
Danziger, K. (1985) The origins of the psychological experiment as a social institution. *American Psychologist,* 40, 133-140.
Davies, G.F. (1983). Math and science education. *Science,* 221, 1006.
Donovan, M.P., Statkiewicz, W.R., Moll, M.B., & Allen, R.D. (1984) *Patterns of intellectual development and science learning.* Unpublished manuscript, West Virginia University, Morgantown. Available from ISEM, 10429 Barnes Way, St. Paul, MN 55075.
Dreifus, C. (1977). *Seizing our Bodies: The politics of women's health.* New York: Vintage Books.
Eagly, A. (1978) Sex differences in influenceability. *Psychological Bulletin,* 85, 86-116.
Ehrenreich, B., & English, D. (1978). *For her own good: 150 years of the experts' advice to women.* Garden City, NY: Anchor Press.
Fausto-Sterling, A. (1981a). The myth of neutrality: Race, sex and class in science. *Radical Teacher,* 19, 21-26.
Fausto-Sterling, A. (1981b). Women and science. *Women's Studies International Quarterly,* 4, 41-50.
Fausto-Sterling, A. (1985) *Myths of Gender: Biological theories about women and men.* New York: Basic Books.
Fausto-Sterling, A., & English, L. (Eds.) (1985). *Reflections on women and minorities in Science.* Brown University [internal publication].
Fee, E. (1983) Women's nature and scientific objectivity. In Lowe, M., & Hubbard, R. *Woman's Nature: Rationalizations of Inequality.* Elmsford, N.Y.: Pergamon Press, 9-28.
Ferber, M.A., & Teiman, M.L. (1981). The oldest, the most established, the most quantitative of the social sciences -- and the most dominated by men: The impact of feminism on

economics. *In* Spender, D. *Men's Studies Modified.* Elmsford, NY: Pergammon Press, 125-140.

Fields, C.M. (1984). Big rise in female engineering majors found; Proportion up from 2 pct. to 17 pct. in 15 years. *Chronicle of Higher Education,* May 9, p. 14.

Fitch, P. & Culver, R.S. (1984). Educational activities to stimulate intellectual development in Perry's scheme. *1984 ASEE Annual Conference Proceedings,* 1-6.

Frankenstein, M. (1983). Radical mathematics. *Radical Teacher,* 21.

Freire, P. (1970). *Pedagogy of the Oppressed.* New York: Continuum (Scribner).

Furumoto, L., & Scarborough, E. (1986). Placing women in the history of psychology: The first generation of American women psychologists. *American Psychologist,* 41, 35-42.

Gelles, R. (1979). *Family Violence.* Beverly Hills, CA: Sage.

Gergen, K.J. (1985). The social constructionist movement in modern psychology. *American Psychologist,* 40, 266-275.

Gilligan, C. (1982) *In a Different Voice.* Cambridge, MA: Harvard University Press.

Giorgi, A. (1970). *Psychology as a human science: A phenomenologically based approach.* New York: Harper & Row.

Golden, M.P. (Ed.) (1976) *The research experience.* Itasca, IL: F.E. Peacock.

Goldstein, A.G., & Bailis, K., & Chance, J. (1983). Do students remember pictures in psychology textbooks? *Teaching of Psychology,* 10(1), 23-25.

Goldstein, E. (1979) Effect of same-sex and cross-sex role models on the subsequent academic productivity of scholars. *American Psychologist,* 34, 407-410.

Golub, S. (Ed.) (1986). *The Psychololology of Women: Resources for a Core Curriculum.* Gardner Press, in press.

Gould, S.J. (1981) *The Mismeasure of Man.* New York: W.W. Norton & Co.

Grady, K.E. (1981) Sex bias in research design. *Psychology of Women Quarterly,* 5, 628-636.

Graham, P.A. (1978). Expansion and exclusion: A history of women in American Higher Education. *Signs,* 3(4), 759-773.

Hacker, S.L. (1981). The culture of engineering: Woman, workplace, and machine. *Women's Studies International Quarterly,* 4(1), 341-353.

Hacker, S.L. (1983). Mathematization of engineering: Limits on women and the field. *In* Rothschild, J. (Ed.) *Machina ex Dea: Feminist perspectives on technology.* Elmsford, NY: Pergammon Press.

Hall, R.M., & Sandler, B.R. (1981). Women in science. Project on the Status and Education of Women, Association of American Colleges, Winter (#29), 11-12.

Hall, R.M., & Sandler, B.R. (1982). *The classroom climate: A chilly one for women?* Washington, D.C.: Project on the Status and Education of Women, Association of American Colleges.

Hall, R.M., & Sandler, B.R. (1983). *Academic Mentoring for women students and faculty.* Washington, D.C.: Project on the Status and Education of Women, Association of American Colleges.

Hall, R.M., & Sandler, B.R. (1984). *Out of the Classroom: A chilly campus climate for women.* Washington, D.C.: Project on the Status and Education of Women, Association of American Colleges.

Haraway, D. (1979). The biological enterprise: Sex, mind, and profit from human engineering to sociobiology. *Radical History Review,* 20, 206-237.

Harrison, A.J. (1982). Goals of Science education. *Science,* 217, 109.

Hein, H. (1981). Women and science: Fitting men to think about nature. *International Journal of Women's Studies,* 1981, 4, 369-377.

Hettich, P. (1980). The journal revisited. *Teaching of Psychology,* 7(2), 105-106.

Hoffnung, M. (1986) Feminist transformations: Teaching Experimental Psychology. *Feminist Teacher,* in press.

Horner, M. (1970) Femininity and successful achievement: A basic inconsistency. *In* Bardwick, J.M., Douvan, E., Horner, M.S., & Gutmann, D. *Feminine Personality and Conflict,* Belmont, CA: Brooks/Cole. Also *in* Garskoff, M.H. (1971) *Roles Women Play: Readings Toward Women's Liberation.* Belmont, CA: Brooks/Cole.

Howard, G.S. (1985). The role of values in the science of psychology. *American Psychologist,* 40, 255-264.

Hubbard, R., & Lowe, M. (Eds.) (1979) *Genes and Gender: II. Pitfalls in Research on Sex and Gender.* New York: Gordian Press.

Hyde, J.S. (1981) How large are cognitive gender differences? A metaanalysis using w and d. *American Psychologist,* 36, 892-901.

Jacklin, C.N. (1979) Epilogue. *In* Wittig, M.A., & Petersen, A.C. *Sex-related differences in cognitive functioning.* New York: Academic Press, 357-371.

Jacobs, K.W. (1980). Instructional techniques in the introductory statistics course: The first class meeting. *Teaching of Psychology,* 7, 241-242.

Kanarian, M.A. (1983). *Factors predicting pattern of math courses and mathematical aptitude test scores among high school men and women.* Doctoral Thesis, University of Rhode Island, Kingston, RI.

Keller, E.F. (1983). *A feeling for the organism: The life and work of Barbara McClintock.* New York: W.H. Freeman.

Keller, E.F. (1985) *Reflections on Gender and Science.* New Haven: Yale University Press.

Kimble, G.A. (1984) Psychology's two cultures. *American Psychologist,* 39, 833-839. See also rejoinder by R.K. Unger (1985) Epistemological consistency and its scientific implications, *American Psychologist,* 40, 1413-1414; and rejoinder by S.B. Messer (1985) Choice of method is value laden too. *American Psychologist*, 40, 1414-1415.

Kneffelcamp, L. (1974). *Developmental instruction: Fostering intellectual and personal growth of college students.* Doctoral dissertation, University of Minnesota, Minneapolis; *Dissertation Abstracts*, 1975, 36(3): 1271A.

Kneffelcamp, L. (1985). *Cross-cultural teaching.* Presented at regional meetings of the National University Continuing Education Association, Lesley College, MA.

Kozma, R.B., Belle, L.W., & Williams, G.W. (1978). *Instructional techniques in Higher Education.* Englewood Cliffs, NJ: Educational Technology Publics.

Lemkau, J.P. (1983). Women in male-dominated professions: Distinguishing personality and background characteristics. *Psychology of Women Quarterly*, 8(2), 144-165.

Leontief, W. (1982). Academic economics. *Science*, 217, 104-105.

Lerner, G. (1979). *The majority finds its past: Placing women in history.* New York: Oxford University Press.

Lips, H.M. (1984). *Math/Science self-schemas and curriculum choices among university women.* Paper presented at annual convension, American Psychological Association, Toronto. (Psychology, University of Winnipeg).

Longino, H., & Doell, R. (1983). Body, bias, and behavior: A comparative analysis of reasoning in two areas of biological science. *Signs*, 9, 206-227.

Lott, B. (1985) The potential enrichment of social/ personality psychology through feminist research and vice versa. *American Psychologist*, 40, 155-164.

Lowe, M., & Hubbard, R. (1983). *Woman's nature: Rationalizations of inequality.* Elmsford, NY: Pergammon Press.

Mackenzie, B. (1984). Explaining race differences in IQ: The logic, the methodology, and the evidence. *American Psychologist*, 39(11), 1214-1233.

Mackosky, V.P. (1985). Teaching psychology in the information age. *Teaching of Psychology*, 12(1), 23-26.

Maher, F., & Dunn, K. (1984). *The practice of feminist teaching: A case study of interactions among curriculum, pedagogy, and female cognitive development.* Working Paper No. 144, Wellesley College Center for Research on Women.

Marshall, E. (1985). The Academy kills a nutrition report. *Science*, 230, 420 [See also Letters to the Editor, 230, 1324-1326].

Martin, J.R. (1985a). *Reclaiming a conversation: The ideal of the educated woman.* New Haven, CT: Yale University Press.

Martin, J.R. (1985b). Becoming educated: A journey of alienation or integration? *Journal of Education*, 167(3), 71-84.

McCall, R.B. (1980). *Fundamental statistics for Psychology, 3rd Edit.* New York: Harcourt Brace Jovanovich.

McDonald, K. (1982). Colleges urged to improve science courses for non-science majors. *Chronicle of Higher Education*, June 16, 8.

McElheny, V. (1986). Swords into plowshares: An interview with Merritt Roe Smith. *American Heritage of Invention and Technology*, 1(3), 34-43.

McHugh, M., Koeske, R., & Frieze, I. (1982) *Guidelines for Nonsexist Research.* Report of the APA Division 35 Task Force on Nonsexist Research, available for $1.50 (check payable to Women's Studies Program) from Dr. Irene Frieze, Women's Studies Program, University of Pittsburgh, Pittsburgh, PA 15260.

McIntosh, P. (1983). *Interactive phases of curricular re-vision: A feminist perspective.* Working Paper No. 124, Wellesley College Center for Research on Women.

McKeachie, W.J. (1986). *Teaching Tips: A guidebook for the beginning college teacher, 8th edit.* Lexington, MA: D.C. Heath.

Miller, J.B. (1976). *Toward a New Psychology of Women.* Boston: Beacon Press.

Milton, O., & Associates (1978). *On College Teaching.* San Francisco: Jossey-Bass Publishers.

Newman, L.M. (1985). *Men's Ideas/ Women's Realities: Popular science, 1870-1915.* Elmsford, NY: Pergammon Press.

Nisbett, R.E., Krantz, D.H., Jepson, C., & Kunda, Z. (1983). The use of statistical heuristics in everyday inductive reasoning. *Psychological Review,* 90(4), 339-363.

O'Connell, A., & Russo, N.F. (1983). *Models of Achievement: Reflections on Eminent Women in Psychology.* New York: Columbia University Press.

Overfield, K. (1981). Dirty fingers, grime and slag heaps: Purity and the Scientific Ethic. *In* Spender, D. *Men's Studies Modified.* Elmsford, NY: Pergammon Press, 237-248.

Parlee, M.B. (1981) Appropriate control groups in feminist research. *Psychology of Women Quarterly,* 5, 637-644.

Perry, W.G. Jr. (1970). *Forms of intellectual and ethical development in the college years: A scheme.* New York: Holt, Rinehart & Winston, Inc.

Perun, P. (1982). *The undergraduate woman: Issues in Educational Equity.* Lexington, MA: D.C. Heath.

Pfafflin, S.M. (1984). Women, science, and technology. *American Psychologist,* 39(10), 1183-1186.

Quina, K. (1981). *The feminist challange to academic psychology.* Presented at the annual meetings, Association for Women in Psychology, Boston, MA.

Quina, K. (1986). "Experimental Psychology" *and* "History and Systems". *In* Golub, S. (Ed.), *Psychology of Women: Resources for a Core Curriculum.* Gardner Press, in press.

Quina, K., Kanarian, M.A., & Stang, D. (1982). *Stress and role conflict in the BMOC (Busy Mom On Campus).* Presented at the national conference, Association for Women in Psychology, Seattle, WA.

Quina, K., & Kulberg, J. (1983). *Analytical thinking skills in the teaching of experimental psychology.* Presented at annual meetings, New England Psychological Association, Providence, RI.

Reinharz, S. (1984) *On Becoming a Social Scientist.* New Brunswick, NJ: Jossey-Bass, Inc.

Roberts, H. (Ed.) (1981). *Doing Feminist Research.* London: Routledge & Kegan Paul.
Rose, S. (Ed.) (1986) *Advice for Women Scholars.* New York: Springer Publishers, in press.
Rossi, J. (1983) Ratios exaggerate gender differences in mathematical ability. *American Psychologist,* 38, 348-349.
Rossi, J. (1984). *Statistical power of psychological research: The artifactual basis of controversial results.* Doctoral Thesis, University of Rhode Island, Kingston, RI.
Rossiter, M.W. (1982) *Women scientists in America: Struggles and strategies to 1940.* Baltimore, MD: Johns Hopkins University Press.
Rothschild, J. (1983). *Machina ex Dea: Feminist perspectives on technology.* Elmsford, NY: Pergammon Press.
Rubenstein, J., & Slife, G.D. (1982). *Taking sides: Clashing views on controversial psychological issues. (2nd edit)* Guilford, CT: Dushkin.
Russo, N.F., & Denmark, F.L. (1984). Women, psychology, and public policy: Selected issues. *American Psychologist,* 39, 1161-1165. [See other articles same issue].
Sadker, M., & Sadker, D. (1985). Sexism in the schoolroom of the '80s. *Psychology Today,* 19(3), 54-57.
Salner, M. (1985). Women, graduate education and feminist knowledge. *Journal of Education,* 167(3), 46-58.
Scarr, S. (1985). Constructing psychology: Making facts and fables for our times. *American Psychologist,* 40(5), 499-512.
Schafer, A.T., & Gray, M.W. (1981). Sex and mathematics. *Science,* 211, 231.
Schuster, M., & VanDyne, S. (1984). Placing women in the liberal arts: Stages of curriculum transformation. *Harvard Education Review,* 54(4), 413-423.
Sherman, J. (1983) Factors predicting girls' and boys' enrollment in college preparatory mathematics. *Psychology of Women Quarterly,* 7, 272-281.
Shields, M. (1984). Keeping Psychology Human: Ulric Neisser, the father of cognitive psychology. *Emory Magazine,* June, 6-13.
Shields, S.A. (1975) Functionalism, Darwinism, and the Psychology of Women: A study in social myth. *American Psychologist,* 30, 739-754.
Simberloff, D. (1984). The great god of competition. *The Sciences,* 24(4), 16-22.
Sloane, E. (1980). *Biology of Women.* New York: John Wiley.
Spanier, B., et al. (1984). *Toward a balanced curriculum.* Cambridge, MA: Schenkman.
Stewart, A.J., & Platt, M.B. (Eds.) (1982) Studying Women in a Changing World. Special Issue, *Journal of Social Issues,* 38(1), 1-124.
Stimpson, C. (1980). The scholarship about women: The state of the art. *Annals of Scholarship,* 1, 2-14.
Sutherland, S.L. (1978). The unambitious female: Women's low professional aspirations. *Signs,* 3(4), 774-794.

Thorne, B., Kramarae, C., & Henley, N. (1983). *Language, gender and society.* Rowley, MA: Newbury House.
Tirman, J. (1984). *The militarization of high technology.* New York: Ballinger.
Traweek, S. (1984). High-energy physics: A male preserve. *Technology Review,* Nov/Dec.
Tversky, A., & Kahneman, D. (1983). Extensional versus intuitive reasoning: The conjunction fallacy in probability judgment. *Psychological Review,* 90(4), 293-315.
Unger, R.K. (1983) Through the looking glass: No wonderland yet! (The reciprical relationship between methodology and models of reality). *Psychology of Women Quarterly,* 8, 9-32.
Unger, R.K. (1986). Personal epistemology and personal experience. *Journal of Social Issues,* in press.
Wallston, B.S. (1981) What are the questions in Psychology of Women? A feminist approach to research. *Psychology of Women Quarterly,* 5, 597-617.
Walsh, M.R. (1986). The Psychology of Women course: A continuing catalyst for change. *Teaching of Psychology,* 12, 198-202.
Ward, E.F. (1984). Statistics mastery: A novel approach. *Teaching of Psychology,* 11(4), 223-225.
Weisstein, N. (1971) Psychology constructs the female, or the Fantasy Life of the Male Psychologist. *In* Garskof, M.H. (ed.) *Roles Women Play: Readings Toward Women's Liberation.* Belmont, CA: Brooks/Cole, 68-83.
White, A.M. (1976). A new paradigm for the mathematics classroom. *International Journal of Mathematics in education, science and technology,* 7(2), 243-246.
Wittig, M.A. (1985) Metatheoretical dilemmas in the psychology of gender. *American Psychologist,* 40, 800-811.
Woolley, H.T. (1910). Psychological literature: A review of the recent literature on the psychology of sex. *Psychological Bulletin,* 7, 335-342.
Yoder, J. (1979). Teaching students to do research. *Teaching of Psychology,* 6(2), 85-88.

Appendix A

Analytical Thinking Skills Approach to Research Methods

The following ideas represent activities in my research methods course reflecting the analytical thinking skills approach.

1. The research *process* is outlined, in circular plan, from theory to hypothesis, design, analysis, interpretation, and back to theory. Emphasis on process enables student to see choices and to identify weak points for bias (Quina & Kulberg, 1983).

2. Perspectives on the meaning of research are gained through:

a) Different findings or views on the same problem (Rubenstein & Slife, 1982);

b) Different theoretical or methodological approaches to a problem: Have students select one topic (e.g., anorexia), and using resource tool such as *Psychological Abstracts,* have each student track down two articles on that topic. Bring articles to class and discuss the various approaches.

c) Different statistical analyses within a single problem: McCall (1980) compares outcome of two separate analyses, correlation and comparative statistics, on data on adopted parents and the inheritance of IQ.

d) Critiques of studies done by others, including abstract and guided analysis through the author's process.

3. Mastery approach (requires practice of skills):

a) Fewer papers assigned, with interactive feedback while writing is underway, and with up to 100% rewrite of early papers.

b) Group solving of practice problems, with discussion.

c) In large classes, advanced undergraduates can receive credit for serving as grading assistants and tutors, for weekly exercises designed to give students practice in important analytical skills.

4. Formal writing: Use of formal style is mandatory, but not for normal reasons. Formal style organizes presentation of research in logical case form, and thus shapes flow of logic in helpful way. Stress logic rather than details like placement of commas.

5. Relationship to personal experience: Analytical skills are applied to everyday experiences and sayings during class practice; for example, students will be asked to give operational definitions for the independent and dependent variables testing the hypothesis "Success breeds success". Students are encouraged to bring in newspaper and other media examples of research, especially flawed research.

More helpful ideas are found in Hoffnung (1986) and in Quina (1986), both in press.