JOURNAL OF RESEARCH IN SCIENCE TEACHING VOL. 35, NO. 8, PP. 951–961 (1998)

Gender Equity: Toward Clarification and a Research Direction for Science Teacher Education

Léonie J. Rennie

Science and Mathematics Education Center, Curtin University of Technology, GPO Box U1987, Perth 6845, Western Australia

Received 15 April 1998; Accepted 18 May 1998

One of the highlights of my participation in the National Association for Research in Science Teaching (NARST) meeting in Chicago in 1997 was a well-attended symposium led by Randy McGinnis and involving Tom Koballa and Ken Tobin. They addressed the issue of gender-inclusive education by reflecting on their situation of being men professors who teach science methods to classes containing a majority of women. As I listened to the speakers in this symposium, three issues about gender equity and research were raised that I felt were particularly important. The first issue was the need to recognize difference in the meaning and the use of the terms *sex* and *gender.* The second issue arose from the clear statement by each of the three participants that trying to ensure that science methods classes are gender inclusive and that their members are committed to gender equity is a difficult and risky business. In fact, McGinnis reported considerable resistance from the members of his science methods class in response to his spending time on matters relating to gender equity. The third issue follows from this. If changing gendered practice is so difficult, why do we want to try, and how should we go about it?

In preparing my comments on these three issues, I have been greatly assisted by reading the full text of McGinnis' action research (McGinnis & Pearsall, 1998), which he could only précis in his part of the symposium paper (McGinnis, Tobin, & Koballa, 1997). I will draw from both these sources to illustrate each of the issues in turn.

Sex and Gender: Same or Different?

Over several years, I have become increasingly perturbed by the use of the word *gender* when the writer or speaker is referring simply to the biological sex of the person. Thus, it was not surprising that for me, two sentences stood out in McGinnis' presentation about his self-study of implementing gender-inclusive pedagogy in his science methods class. The first sentence was, "I came to realize that while I could not serve women in my science methods class as a gender role model in science teaching, I could serve as a teacher role model" (McGinnis et al., 1997, p. 8). The second sentence (which includes a quotation from Keller) was, "My co-researcher and I came to recognize that 'gender is what culture makes of sex'" (p. 8).

As an invited reactant to the symposium, I chose to address briefly the distinction between sex and gender. Then, just a couple of days after this symposium, the issue rose again unex-

 CCC 0022-4308/98/080951-11

pectedly as the world learned of the mass suicide of 39 of Heaven's Gate cult members at Rancho Sante Fe, California. As one television program broadcast the unfolding events, the anchor person in the television studio asked the reporter on the scene, "Are all the bodies of the same gender? Are there women as well as men?" Clearly, the person in the television studio was interested not in gender, but in the biological sex of the bodies, and the event highlighted the current ambiguity in the meanings of the terms "sex" and "gender." Apart from the construction of clumsy phrases such as "same-gender bodies" and "single-gender schools", there is another more important issue: If we use the word "gender" when we refer to biological sex, what word do we use when we want to refer to the cultural meaning we construct around what it means to be male or female?

McGinnis began his action research because of interest in gender equity, although his original concern was prompted by a comparison based on sex. McGinnis described his sudden realization that the group of science educators in which he found himself, "predominately consists of men while my teaching experience on the collegiate level suggests that the prospective teachers in elementary methods courses are predominately women" (McGinnis et al., 1997, pp. 6–7). In his journal, McGinnis questioned

> why this difference exists between me and the majority of my class? . . . What implications does this have for my work? I am fearful that I will find I am enjoying privilege primarily because I am a man and that my students might feel oppressed by a system in which imbalance of power between women and men exists. (McGinnis & Pearsall, 1998, p. 929)

Thus, a difference in the proportion of men and women in the two groups, a sex difference, was extrapolated to questions about gender difference. His subsequent research attempted to find answers via a self-study of his efforts to implement a gender-inclusive pedagogy in his science methods class. By enlisting the aid of a female coresearcher, he hoped that "through different gender perspectives the study would be richer and lead to greater insights" (McGinnis & Pearsall). Reading the full report indicates that this was indeed the case. Importantly, McGinnis found that "his worst fear was not realized." The fact that he was a male did not disrupt the learning of the women in his science methods class, and, as noted earlier, he could serve them as a teacher role model if not a gender role model.

"Gender" is a relatively new term in the psychological and educational literature. In 1979, Unger argued for a distinction to be made between sex, which is biologically determined, and gender, which is a sociological label referring to "those non physiological components of sex that are culturally regarded as appropriate to males and females" (Unger, 1979, p. 1086). At that time, Unger suggested the term "sex" was too inclusive and that the study of gender differences was far more productive than the study of sex differences. Less than 20 years later, we seem to have a situation where "gender" has become the more inclusive term, and the result again has been ambiguity and confusion in meaning. What is wrong with the word "sex" that authors wish to replace it with "gender"? Perhaps our attempts to make language nonsexist have been overzealous and we have attempted to remove the word "sex" altogether!

When researchers report that their sample included 16 boys and 14 girls, or mention in passing that there was no statistically significant difference between the mean scores of males and females, they are writing about sex differences, not gender differences. However, when researchers attempt to describe or explain differences between the scores of males and females in terms of their masculine or feminine behavior, or in terms of how males and females are treated or considered differently by others on the basis of their sex, these researchers are writing

about gender differences, differences based on socially or culturally determined behavior which are responsive to people's biological sex.

In our discussions in science education, in our research, and in our classes, we need to attend carefully to the terminology we use and we must make it unambiguous. Unger and Crawford (1992) put the argument simply:

> It is important to distinguish sex from gender for two reasons. First, equating them can lead to the belief that differences in the traits or behaviors of men and women are due directly to their biological differences, when the traits or behaviors actually may be shaped by culture. Second, keeping the concepts of sex and gender distinct can help us to analyze the complex ways they interact in our lives. (p. 18)

Resistance to Promoting Gender Equity

The complex interaction between sex and gender referred to by Unger and Crawford was displayed abundantly in the McGinnis–Pearsall study. Their description of the gender-inclusive pedagogy McGinnis strove to introduce in his science methods class is comprehensive, and the strategies chosen are anchored firmly in the body of research in gender equity. Yet, although the teacher candidates could recall and recognize gender bias which had occurred in their own learning of science, there was clear resistance from both males and females to McGinnis' efforts. He gave his reaction honestly:

> I expected the males would initially be resistant as a result of a loss of privilege but would eventually come to a deeper understanding of gender, equity, and social justice and see my efforts as modeling ways in which they could teach in elementary school contexts. As hard as I tried to avoid acknowledging it, I felt let down by the women teacher candidates' resistance. If anything, I felt they should be protecting me in this innovation since it was in their best interests as females in science. (McGinnis & Pearsall, 1998, p. 936)

Acknowledging their own gendered perspectives, McGinnis and Pearsall (1998) tried to find explanations for the resistance, particularly from the women teacher candidates. Several ideas presented. A possible explanation related to the effects of McGinnis announcing at the outset of the semester that he was researching his own practice with a focus on gender-inclusive pedagogy, and his occasional lapses in using nonsexist language. Together, these may have suggested that McGinnis was inexperienced, and given that the teacher candidates said they placed high priority on having an experienced, informed methods lecturer, this may have triggered some negative reaction. Also, perhaps teacher candidates thought McGinnis himself had a problem with gender equity which he (rather than they) needed to get fixed. Indirect support was given for this explanation by the lack of resistance from teacher candidates in the subsequent semester when the same pedagogical approach was used without an overt announcement.

The most important reason for resistance, however, seems to be that the teacher candidates did not seem to consider that gender equity was a problem *for them.* McGinnis and Pearsall (1998) concluded that most teacher candidates did not initially recognize the gender inequities of the sociological factors which differentially promote males and females, especially with respect to science; hence, they resisted being forced to reflect on the issues. This is not to say that the teacher candidates were unaware of issues relating to gender; there is considerable evidence presented, particularly in Pearsall's viewpoints, that the teacher candidates, including both males and females, were gender aware. They reported instances of gender bias from their teachers, and

supposed that they held different expectations for boys and girls. They also believed that male and female teachers and professors taught science differently—that is, teaching could be gendered in stereotypical ways. Nevertheless, they said that having a male science method professor did not bother them; in fact, they rather expected it.

Pearsall noted that although the teacher candidates recognized gender bias, they did not speak out against it. Further, McGinnis' overt attempts to instill gender-inclusive pedagogy were regarded by many teacher candidates as an imposition that they found neither necessary nor desirable. Clearly, the teacher candidates were willing to accept rather than challenge the status quo. Indeed they seemed to see the issue as peripheral to what they were in the science methods class to do—that is, to learn how to teach science.

An additional explanation for this resistance may be drawn from Fuller's (1969) developmental conceptualization of teachers' concerns. McGinnis' teacher candidates were at what Fuller termed the pre-teaching phase, before they enter the classroom as teachers. Fuller's research suggested that here they are concerned primarily with learning what it takes to survive as a teacher in the classroom. How to teach science and how to deal with children in the classroom are the topics most likely to be of concern to them. But until they actually get into a classroom themselves, their ideas about even these concerns are likely to be vague and unfocused. Fuller proposes that in the early teaching phase, when teaching starts, teachers become concerned with themselves and their own performance: What do I do? Will I cope? How am I going? It is not until a later phase, when teachers feel some sense of self-adequacy, that they become concerned about students and how they are progressing.

Fuller's conceptualization suggests that for teacher candidates, interest in and concern about dealing with an issue such as gender equity is likely to be vague and diffuse unless dealing with it becomes a matter of immediate concern. A point made by McGinnis and Pearsall (1998) is consistent with this explanation. They found later, from their participant member check, that at least one of the teacher candidates had experienced the need during teaching practice to enact strategies which would benefit both girls and boys. However, other teacher candidates, for whom that need had not arisen, felt that putting energy into challenging the status quo and trying to change the system (which produced more male than female science teacher educators) simply took energy away from learning how to teach science.

McGinnis was not alone in finding resistance when implementing a pedagogy designed to be more inclusive of females. During the symposium, Koballa recounted briefly his attempts in his science methods class to move the females' understanding about science "along the development pathway" (McGinnis et al., 1997, p. 13) from being received knowers to connected knowers (Belenky, Clinchy, Goldberger, & Tarule, 1986). However, he found his attempts to "challenge their conceptions of the nature of science to be of little value" (p. 15), and concluded that this approach was not an effective model for him and his teacher candidates at that time. Haggerty (1995) also reported an action research project in which the development of teachers' conceptions of science and science teaching and learning were investigated. Gender and science was one topic included. She reports that gender was of no concern for many of the teacher candidates. They recognized different participation of females and males in science, but it was not perceived as a social issue. In fact, a few of the teacher candidates were angered by time spent on gender issues.

The expression of anger does not surprise those involved in gender research who attempt to disturb the status quo in the quest for gender equity. In the case of gender interventions, the spotlight usually falls on women and girls, and they do not enjoy the attention. It seems that by apparently isolating one group (such as females) in an intervention and pointing out aspects of disadvantage, there is an implication that the other group (in this case, males) is somehow to

blame. Sometimes the unintended result is anger and aggression as the inference of blame is resisted, often by both sexes. Kenway and Willis (1998) documented numerous occurrences among teachers and others in schools where gender-related interventions were attempted and strong emotions were aroused against those who chose to challenge the status quo.

Clearly, introducing reforms with an overt gender focus is not easy. It is certainly not easy in science methods class; yet, McGinnis and Pearsall (1998, p. 944) "remain firmly committed to the belief that they [gender and social inequities] should be [recognized] if the cycle of inequity in science teaching and learning for females is to be broken." Science teacher educators, both male and female, must be regarded as key agents who can encourage teacher candidates (of both sexes) to reflect upon their own views and experiences in such a way that gender inequity becomes problematic for them. It is only when gender equity is a concern for teacher candidates (and teachers and science teacher educators) that they will commit themselves to developing gender-inclusive practice. The problem, then, is how to do this more easily.

Addressing Gender Equity in Science Teacher Education

In his contribution to the NARST symposium, Tobin wrote,

> I believe that the gendered nature of the discourse that occurs in those communities of intending and practicing teachers [is] of critical importance. What is of greatest importance in the preparation of science teachers is to construct and maintain learning environments in which participants can co-participate via the agency of a shared as [sic] negotiated language. (McGinnis et al., 1997, pp. 10–11)

"Accessing and appropriating a shared language," as Tobin put it (p. 11), means that all participants in the science methods class can understand and communicate with each other in mutually respectful ways. In the context of gender, I think that part of the explanation for resistance, and hence, part of the answer for dealing with it, lies in recognizing that gender equity can be viewed from different perspectives, and science teacher educators can make progress more easily if they are able to recognize and work with the perspectives held by the teacher candidates in their science methods class. Unless we recognize each other's perspective, communication will be difficult and shared progress impossible.

This was the message I tried to present at an earlier symposium during the 1995 NARST meeting in Atlanta, organized by Vince Lunetta and Tom Dana, which focused on a research agenda in science teacher education. At that symposium, I borrowed from Sue Willis (1996) a model of four perspectives on the relationship between the mathematics curriculum, disadvantage, and social justice. Willis identified four perspectives, or ways people use to understand the problem of disadvantage for members of social groupings, such as gender, culture, social class, or language, the perceived means to its solution, and the consequent educational task associated with attempting to achieve social justice in each perspective. I have found that the model adapts readily to science education and perceived disadvantage relating to gender, and I want to reiterate these four perspectives here, because I believe they offer a way of thinking about gender equity in science which can contribute toward better communication in science methods classes, and beyond.

Four Perspectives on Gender and Science Education

Rephrasing Willis' first perspective in terms of gender and science, the problem of disadvantage is constructed to be that some students, by virtue of their gender, are less well pre-

pared than others to benefit from science education. In this perspective, the solution is to compensate for this lack of preparation, and lies with providing those students with the missing skills or experiences (such as familiarity with science equipment), attitudes, or motivation to study science. Willis referred to this as a remedial perspective, and it is widely recognized as a deficit model—There's something wrong with/missing from girls, so we need to compensate them for it.

The second perspective considers the problem of disadvantage to lie in the way that the science curriculum is taught or assessed. If pedagogical practice favors one sex or the other—for example, if teachers are found to interact more with boys than girls—or if assessment is based on questions which favor the background experiences of one sex more than the other, then the result will be gender-based differences in outcomes. The solution to the problem viewed from this perspective is to consider students' background and experiences and provide the kinds of learning environment and assessment tasks which enable them to achieve their best. The educational task would be to eliminate those aspects of pedagogy and practice which are not gender equitable and to employ nonsexist classroom strategies. Willis calls this a nondiscriminatory perspective, or nonsexist when the focus is on gender.

Whereas the first two perspectives do not question the content of the curriculum (or the nature of science), the third perspective regards the science curriculum itself as the source of the problem, because its content and sequence reflect the kinds of dominant values which are stereotyped with respect to gender. Thus, students in nondominant social groups, like females, are forced to learn a science which is less well matched to their interests and experiences. For example, Kelly's (1985) article demonstrated how the image of science is masculine (we might now describe it as White, Western, and middle class as well) and how that image is portrayed and perpetuated. The solution in terms of this perspective of disadvantage is to rethink the nature of the students who do science (or who we wish to do science) and to structure the curriculum to accommodate in a more inclusive way the interests, attitudes, social experiences, and values of all those students. This perspective is usually referred to as gender inclusive or female friendly.

In Willis' (1996) fourth perspective, the science curriculum is viewed as actively implicated in producing and reproducing gender inequality. The content and practice of science work to maintain the dominant culture, values, and group interests, as suggested by a view of science as male, White, Western, and middle class. When science is viewed from this perspective, the problem of gender equity in science education can be interpreted in terms of the ways in which the science learner is constructed through the curriculum and how science is used both inside and outside of schools to position and privilege some people over others in ways which are gender based. Thus, science itself and the science curriculum are perceived as gendered in a way which favors one group over another—in this case, males over females. The solution to the problem of inequity in this fourth perspective is to challenge the hegemony of science (which means that participants must recognize the hegemony) and modify its use to serve students in a way which is more just in a social sense. The educational task in this perspective is to examine the ways in which science and science curriculum are constructed and to reconstruct our views of who does science and what it means to be good at science. Willis called this a socially critical perspective. To adapt her words about mathematics to the present context, the aim for science teacher educators is to assist teacher candidates, and through their efforts, schoolchildren, "to understand how they and others are positioned by school [science] and to decide what they want to do about it, and how to use [science] in their own interests and in the interests of social justice" (Willis, 1996, p. 48).

Willis was careful neither to critique these perspectives nor to favor one over the other. Rather, she presented them as a framework for others to use to "understand, compare and evaluate various strategies for addressing gender differences in school mathematics" (1996, p. 51). It seems to me that each of these perspectives can be recognized in contemporary science education research and that they have appeared in a chronological way. Although all four still exist, current thought with respect to gender equity in science classrooms (and science methods classes) favors the socially critical perspective. For example, McGinnis and Pearsall (1998, p. 944) suggested that "male science educators should recognize their presence in elementary science method courses primarily populated by females as a privilege that is a result of large scale sociological factors which have differentially promoted males and females." Furthermore, I suggest that looking at gender equity and science education from the socially critical perspective is consistent with Tobin's statement that "it behooves science educators to examine the gender equity issues that persist through the lenses of post-modern thinking" (McGinnis et al., p. 11). Willis' framework offers opportunities to recognize the perspectives of others, and so help to identify and understand the source of resistance to the implementation of gender-inclusive pedagogy, and to suggest ways by which science teacher educators and teacher candidates can move toward a shared language.

There is considerable evidence in the McGinnis and Pearsall (1998) report that often the teacher candidates and the researchers were viewing the issues of gender equity from different perspectives. For example, most of the strategies for gender-inclusive pedagogy described by McGinnis and Pearsall are based in the second or third perspective, the nondiscriminatory or gender-inclusive perspectives. Thus, for example, McGinnis' attempts to be nondiscriminatory by not favoring males in teacher–learner interactions, and by ensuring that females shared responsibilities in small-group work, were interpreted by some teacher candidates as discriminating in favor of females in an inequitable way. Not surprisingly, there was resistance from the males and from those females who could not understand why they seemed to be favored. Pam is quoted from interview as saying, "if you're trying to keep people equal, and you're trying to respect people the same way, then why would you change things to teach female students better?" (McGinnis & Pearsall, 1998, pp. 936). Why indeed? The crucial point here is Pam's view that people (males and females) are positioned equally to begin with. Clearly, this is not the view of the researchers, who wrote (p. 942): "Future teachers should recognize that because girls and boys enter science classrooms with different prior socially constructed experiences and expectations, it is not satisfactory to treat both genders identically." As McGinnis and Pearsall discovered, encouraging teacher candidates to treat boys and girls differently according to their different needs has little chance of success if the teacher candidates firmly believe that everyone should be treated the same. This emphasizes the difficulty of achieving success in the short term. However, in the longer term, as the teacher candidates become practicing teachers, the gender-inclusive pedagogy experienced in the science methods class may equip them to cope more effectively when they recognize instances of inequity.

Implications for Science Teacher Education and Research

I have argued that the major problem to be overcome in promoting gender equity in science and science education relates to a lack of communication between teacher candidates, science teacher educators, and researchers, resulting from different perspectives for constructing the relationship between gender and the science curriculum. Thus, the major challenge in implementing a gender-inclusive pedagogy in science methods classes is to find ways that enable teacher

candidates to have a perspective of gender equity and science which makes them want to promote gender equity and to have the strategic and theoretical tools that enable them to do so.

Putting the challenge this way hardly makes it seem easy, and we have seen already that it is not. So where can we start? The first step is to accept responsibility for starting, and to believe, like McGinnis & Pearsall (1988, p. 944), "that only by taking risks in our teaching of science methods and by systematically reflecting on those efforts" will progress be made. The second step is finding a place to start. In her work, Willis (1996, p. 50) found that "locating particular teachers' views of gender and the mathematics curriculum within [her] broad perspectives has proved helpful in understanding their practices, their concerns, and their personal conflicts." The same approach can be used effectively by science teacher educators to understand the perspectives and positions of teacher candidates, thus promoting the possibility of communicating through a shared language, and enabling teacher candidates and science teacher educators together to move toward a more gender-inclusive science teaching.

This is not the forum to list strategies about how this might be done; my purpose has been to present a framework for understanding the issue, but I will touch briefly on three strategies which build on the findings of Koballa and of McGinnis and Pearsall before drawing implications for research from the NARST symposium and the preceding discussion. The first suggestion comes from McGinnis and Pearsall (1998, p. 942), who "prefer to entice rather than dictate changes in attitudes, beliefs, and behavior involving gender-inclusive teaching practices." The implication is to model gender-inclusive pedagogy, to build it into the course, rather than announce it as a whole-semester focus which seemed to provoke some resistance. Of course, being unobtrusive about gender-inclusive pedagogy risks being invisible, so ways must be found to make it visible without confrontation. One possibility is to use case studies of real classroom incidents as the basis for discussion, enabling teacher candidates' views to be recognized in a respectful way and to begin a shared dialogue about the issues relating to science and gender equity.

A second suggestion comes from Koballa's (1997) findings that teacher candidates want to learn about instructional strategies that engage both boys and girls, and to know about resources that tell how science lessons can be structured to ensure equal opportunities for boys and girls. A focus on those issues which interest teacher candidates may be a safe place to begin. Note that these interests seem to reflect Willis' nondiscriminatory perspective. It would be unwise to expect teacher candidates with this view to cope with the presentation of a socially critical perspective without providing a bridge between the perspectives. Koballa also noted that the teacher candidates wanted information about resources that describe the scientific contributions of women. Taking the teacher candidates into the lives of these women and the contexts in which they were able to make their contributions, and the context which prevented recognition of the contributions of other women, may provide opportunities to build the bridges which enable teacher candidates to move their perspective toward one which is more understanding of science and the way it is structured.

This leads to the third strategy: Be opportunistic. Seize the opportunities which present themselves to encourage teacher candidates to examine their own views and perspectives and thus open windows to enhanced understanding. McGinnis provided a good example. When one of his teacher candidates drew attention to his being politically correct when he used the feminine pronoun in reference to a scientist, he was able to turn this into what he "believed was a productive class discussion on the use of language in the science classroom and how it was posited as contributing toward students' negative attitudes and beliefs concerning science and, in particular, girls' ability to succeed in science" (McGinnis & Pearsall, 1998, p. 934).

Implications for Research

Perhaps the most important implication to be drawn from the symposium and McGinnis and Pearsall's article is the power of research as a means for practitioners to examine their own practice. As Tobin pointed out, "it is an imperative for all science teacher educators to be researchers in their own classrooms such that they can undertake critical reflection on their own practices" (McGinnis et al., 1997, p. 11). I think three issues are particularly significant in terms of gender equity.

The Gender Issue Is Complex. To this point, I have been writing about gender as if it were a readily identifiable variable (like sex) easily dealt with in research. Of course, it is not. The complexities of being boys or girls at school are masked by using gender as a broad-brush classification, rendering all boys and all girls the same. If the issue of gender is to be considered effectively in science teacher education, account must be taken of the way gender is constructed in terms of ethnicity, class, religion, race, and often other variables as well. Gender interacts with other grouping variables such as race, religion, culture, language, socioeconomic status, and access to economic capital. It also interacts in ways which complicate the research process enormously. It is certainly helpful to distinguish between sex and gender in trying to untangle relationships, but researchers need to realize that comprehensive research about gender will almost always involve other variables.

There Is No Single Way. Tobin (in McGinnis, et al., 1997, p. 11) put it rather well: "There will be no grand narratives to guide all methods classes in all universities." Circumstances are different, people are different, and perspectives are different. For some time at least, science teacher educators may find that solutions may be individual to themselves and that particular group of teacher candidates. But through the research of those like McGinnis and Pearsall (1998), Haggerty (1995), and Roychoudury, Tippins, and Nichols (1995), who are willing to try new approaches, reflect on them, and tell others about their findings, the steps we make will mostly be forward.

Different Perspectives on Gender Equity Must Be Recognized. I have emphasized the importance of a shared language in science teacher education, and it is just as important to strive for shared communication among science education researchers. Returning to Willis' four perspectives on the relationship between the mathematics curriculum, disadvantage, and social justice is helpful here. When adapted to science and the science curriculum, each represents a different way of thinking about gender equity and so each defines the research agenda in a different way. We can trace these four perspectives in science education research.

Most of the early research on gender focused primarily on documenting differences between females and males in science, identifying barriers to the participation of girls and women in science at school and beyond, and suggesting to teachers and science teacher educators how those differences might be reduced and the barriers broken down. Sometimes those strategies reflected a rather compensatory approach to gender equity, providing ways of helping girls overcome perceived deficiencies which worked against their participation and achievement in science. Other research was directed toward identifying those aspects of pedagogy and practice which were not gender equitable and developing more equitable classroom strategies. These research strands reflect Willis' remedial and nondiscriminatory perspectives.

During the 1980s, it became increasingly evident that pedagogical practice and the presentation of science in many classrooms reflected social and cultural stereotypes which were masculine, resulting in curriculum better suited to boys. Research questions became concerned with how well the needs, learning styles, and values of the girls and boys were considered in the science classroom, and aimed to find ways in which the curriculum and pedagogy could cater more effectively for those needs and learning styles. Research assisted in the development of science materials and resources as well as teaching strategies which were variously labeled as "girl or female friendly," "nonsexist," "gender equitable," or "gender inclusive."

As the focus of the research changed, so did the methodology. Much of the early research which established the field was necessarily large scale and quantitative, mapping and drawing attention to differences in participation, retention rates, achievement, and attitudes. Such research continues to have a valuable monitoring role, but it is somewhat removed from those people in schools and classrooms whose statistics are of interest. As research questions began to focus on pedagogical practice and resources, research itself moved into the classroom. Attention to process rather than outcomes required more qualitative methods, using, for example, observations of classroom happenings and interviews with teachers and students. Researchers recognized that they must attend to the participants' own constructions of science and science learning, and that they must listen to girls and boys, and to male and female teachers, to learn about their lives and their experiences in science. Science educators, and particularly science teacher educators, must use the outcomes of such research to reflect critically on the practice of science and science teaching.

Thus, understanding of gender equity has grown and diversified as the frameworks used for thinking about the issue have changed. Many science teacher educators and researchers now interpret gender equity in terms of the ways in which science is used in society and in schools to privilege members of dominant cultural and social groupings, including gender. Research questions in this socially critical perspective are framed to explicate the ways in which science and science curriculum are constructed and what that means for the learners, and to investigate ways to help students of both sexes to recognize and challenge the hegemony of science and its consequences for them.

When Krockover and Shepardson (1995) drew attention to what they called "the missing links" in gender equity research in science education, they emphasized the need for race, ethnicity, class, and sociocultural identities to be included in understanding participation in science. They also called for changes in research practice to support more holistic and collaborative research methods. In these comments, I have stressed the need for unambiguous meaning between sex and gender and presented a framework which highlights the different perspectives underlying different approaches to research in gender equity. All of these approaches to research may be found in current science education journals. One kind of approach is not necessarily better than others, because different approaches answer different questions and serve different purposes. The important point is that unless their diversity is recognized, researchers from the different perspectives will find it rather difficult to communicate with each other. Our challenge as both science teacher educators and researchers is to build upon and extend what has gone before so we can move forward in a more coherent and collaborative way.

References

Belenky, M.F., Clinchy, B.M., Goldberger, N.R., & Tarule, J.M. (1986). *Women's ways of knowing: The development of self, voice, and mind.* New York: Basic Books.

Haggerty, S.M. (1995). Gender and teacher development: Issues of power and culture. *International Journal of Science Education, 17,* 1–15.

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

Kenway, J., & Willis, S., with Blackmore, J., & Rennie, L. (1998). *Answering back: Girls, boys and feminism in schools.* New York: Routledge.

Krockover, G.H., & Shepardson, D.P. (1995). The missing links in gender equity research. *Journal of Research in Science Teaching, 32,* 223–224.

McGinnis, J.R., & Pearsall, M. (1998). Teaching elementary science methods to women: A male professor's experience from two perspectives. *Journal of Research in Science Teaching, 35,* 919–949.

McGinnis, J.R., Tobin, K., & Koballa, T.R., Jr. (1997, March). *Teaching science methods to women: Three tales of men professors reflecting on their practice.* Symposium presented at the annual meeting of the National Association for Research in Science Teaching, Oak Brook, IL.

Roychoudury, A., Tippins, D.J., & Nichols, S.E. (1995). Gender-inclusive science teaching: A feminist-constructivist approach. *Journal of Research in Science Teaching, 32,* 897–924.

Unger, R. (1979). Toward a redefinition of sex and gender. *American Psychologist, 34,* 1085–1094.

Unger, R., & Crawford, M. (1992). *Women and gender: A feminist psychology.* Philadelphia: Temple University Press.

Willis, S. (1996). Gender justice and the mathematics curriculum: Four perspectives. In L.H. Parker, L.J. Rennie, & B.J. Fraser (Eds.), *Gender, mathematics and science: Shortening the shadow* (pp. 41–51). Dordrecht, The Netherlands: Kluwer Academic Press.