

Gender Equity Course for Science Teachers: A Pilot Study

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Efforts to address the underrepresentation of women in careers in the physical sciences and engineering generally focus on engaging female students and range from summer science programs (Baker, Lindsey, & Blair, 1999) to curricular role model projects (Evans, Whigham, & Wang, 1995) to one-day career conferences (Conwell & Prichard, 1992).

Another approach focuses on preparing teachers to recognize and promote gender equity in their classrooms. Jones and Wheatley (1990) have documented gender differences in quality and quantity of teacher-student interactions in science classrooms. Guzzetti and Williams (1996) reported that students are aware of gender differences in science classrooms and that differential language patterns exist between female and male students in these classes. Plucker (1996), in his survey of 56 secondary mathematics and science teachers, found that despite their self-reported familiarity and concern with gender equity in science and mathematics, the teachers demonstrated a lack of comprehensive knowledge of how their actions may be promoting inequities and a lack of knowledge of effective interventions. Several studies have examined the practices and problems of attempting to incorporate gender inclusive information and strategies into preservice science teacher education courses (Ambrosio, McDevitt, Gardner, & Heikkinen, 1991; Bullock, 1997; McGinnis & Pearsall, 1998; Richmond, Howes, Kurth, & Hazelwood, 1998; Sanders, Campbell, & Steinbrueck, 1997; Scantlebury, 1994).

A National Science Foundation grant was developed to encourage greater female participation in the physical sciences. This grant provides for several extracurricular programs: an after-school physics program for elementary girls; an evening science and technology program for middle school students and their parents; a Saturday industry-based program for junior high students; and summer residential integrated physical science/mathematics camp for

high school females. Further support is provided to the local schools for curricular programs in the physical sciences. The final component of the grant emphasizes teacher training in the areas of physics content and gender equity. It is this final gender equity teacher training component that is the focus of this study.

The gender equity course described in this pilot study was designed to raise awareness of gender equity issues among K-12 practicing science teachers, and to provide these teachers with opportunities to examine their own teaching and with strategies to make their classrooms more equitable. The class met once per week over a 12-week period. The 13 participants in the course included two elementary school teachers (grades 2 and 4), two specialist teachers of fourth and fifth grade science, one teacher of seventh grade general science and social studies, one teacher with a self-contained classroom for at-risk high school students, two eighth grade general science teachers, two ninth grade general science teachers, two high school chemistry teachers and one high school physics teacher. The teachers were employed by four school districts in the mid-Missouri area.

The content of the course focused on research conducted in the areas of student-teacher interactions, curriculum, pedagogical strategies, language usage, assessment, and technology usage. Other topics that were discussed included Title IX and other legislation related to gender equity in schools and the impact of neurobiological learning research on instruction. Throughout the course, the teachers were reflecting on three, 30-minute videotapes that had been made of their teaching prior to the beginning of the course and were reflecting on ways to apply the research findings to their classrooms. To assess their learning in the course, the teachers completed weekly journals, a report on a biographical trade book about a woman scientist, and a brochure outlining classroom equity strategies. At the culmination of the course, the teachers

each developed an action plan relating to one of the topics covered in the class to be implemented in their classrooms the following year. The class participants also produced a 15-minute video to be used to raise awareness of these issues among their fellow teachers.

Methods

The gender equity course was evaluated using a pre-post survey instrument and by examination of course assessments the teachers completed. The survey instrument was designed to measure changes in awareness of gender equity issues and to compare previous formal educational exposure to gender equity information and strategies to exposure gained in this course. The instrument was constructed by the course instructors and was reviewed by a panel of science educators. It was administered at the first class session and at the final class session 12 weeks later. Thirteen teachers completed both the pre- and post-course surveys. One teacher completed only the pre-course survey and withdrew from the class after the second class session, and was therefore deleted from analysis. The evaluation questions consisted of 12 items scored on a 4-point Likert scale (1=low and 4=high) and two questions with open-ended responses.

Findings

Instrument: Quantitative. The first subscale, Issue Awareness, consisted of six Likert-scale items concerned with the teachers' awareness of the following gender issues: under-representation of females in science; research findings related to gender equity; teacher-student interaction patterns favoring females; teacher-student interaction patterns favoring males; gender stereotypes associated with careers in science-related fields; and use of inclusive language patterns and metaphors. Scores on the Issue Awareness subscale ranged from 11 to 19 on the pre-survey (mean = 15.31) and 15 to 24 on the post-survey (mean = 20.85). Using the paired-

samples t-test statistic to compare the pre-survey and post-survey means, a significant ($p < .00$) increase in knowledge in these areas was reported.

The second subscale, Formal Education, consisted of six Likert-scale items comparing the teachers' previous formal education (methods and inservice courses) exposure to the following topics to their exposure in the gender equity course: techniques for observing and documenting gender equity; practical instructional suggestions for making classes more equitable; ways to examine for gender bias in curricular materials; resources to support equitable teaching; Title IX and other laws pertaining to gender equity in schools; and classroom environments that promote equitable participation. Scores on the Formal Education subscale ranged from 6 to 18 on the pre-survey (mean = 8.85) and 18 to 24 on the post-survey (mean = 20.35). Again, the paired-samples t-test statistic was used to compare the pre- and post-survey means, which were found to be significantly ($p < .00$) different, indicating more exposure to these topics in the gender equity course than in previous formal educational experiences. Tables 1 and 2 summarize these findings.

Table 1. Comparison of pre- and post-survey data on two subscales of gender equity course instrument.

| | Issue Awareness Pre-Survey | Issue Awareness Post-Survey | Formal Education Pre-Survey | Formal Education Post-Survey |
|---------|-------------------------------|--------------------------------|--------------------------------|---------------------------------|
| Minimum | 11 | 15 | 6 | 18 |
| Maximum | 19 | 24 | 18 | 24 |
| Mean | 15.31 | 20.85 | 8.85 | 20.35 |

Table 2. Paired-samples t-test for two subscales on gender equity course instrument.

| | Paired differences | | | | Lower | Upper | t | df | p |
|---------------------------------------|--------------------|------|------|-----------------------------|-------|-------|----|-----|---|
| | Mean | SD | SEM | 95% Confidence Intervals | | | | | |
| Issue Awareness (Post vs. Pre) | 5.54 | 3.86 | 1.07 | 3.20 | 7.87 | 5.17 | 12 | .00 | |
| Formal Education (Post vs. Pre) | 11.50 | 3.34 | 0.93 | 9.49 | 13.52 | 12.42 | 12 | .00 | |

Table 3 provides information on the means and standard deviations by each item reported by gender of the teacher. The sample size for each of these groups was too small to warrant formal statistical analysis. Upon visual examination of the means, it can be seen that females had higher mean scores on four of the six items in the Issues Awareness subscale (interaction patterns favoring females and males, science gender stereotypes, and inclusive language patterns) and in five of the six items in the Formal Education subscale (observation techniques, instructional strategies, curricular evaluation, teaching resources, and classroom environments)

Table 3. Mean values for each item on pre- and post-survey by teacher gender.

| | | Pre-survey | | | | Post-survey | | | |
|---------------------------|---------------------------------------|--------------|------|------------|------|-------------|------|------|------|
| | | Female (N=7) | | Male (N=6) | | Female | | Male | |
| | | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Issue Awareness Subscale | Under-representation of females | 3.00 | 0.82 | 3.17 | 0.41 | 3.71 | 0.48 | 3.67 | 0.52 |
| | Gender equity research | 1.86 | 0.69 | 2.17 | 0.75 | 3.57 | 0.53 | 3.50 | 0.55 |
| | Interaction patterns favoring females | 2.29 | 0.49 | 1.83 | 0.75 | 3.43 | 0.53 | 2.83 | 0.98 |
| | Interaction patterns favoring males | 2.43 | 0.53 | 2.33 | 1.03 | 3.43 | 0.53 | 3.33 | 0.52 |
| | Science gender stereotypes | 3.29 | 0.48 | 3.00 | 0.89 | 3.57 | 0.53 | 3.83 | 0.41 |
| | Inclusive language patterns | 2.86 | 0.90 | 2.33 | 0.52 | 3.57 | 0.53 | 3.17 | 1.17 |
| Formal Education Subscale | Observation techniques | 1.57 | 0.79 | 1.33 | 0.52 | 3.43 | 0.79 | 3.67 | 0.52 |
| | Instructional strategies | 1.86 | 0.90 | 1.50 | 0.84 | 3.43 | 0.53 | 3.50 | 0.55 |
| | Curricular evaluation | 1.57 | 0.79 | 1.17 | 0.41 | 3.43 | 0.53 | 3.33 | 0.52 |
| | Teaching resources | 1.43 | 0.79 | 1.00 | 0.00 | 3.28 | 0.49 | 3.33 | 0.52 |
| | Equity legislation | 1.43 | 0.79 | 1.83 | 0.75 | 3.43 | 0.79 | 2.67 | 0.52 |
| | Classroom environments | 1.71 | 0.76 | 1.16 | 0.41 | 3.80 | 0.38 | 3.33 | 0.52 |

on the pre-survey. On the post-survey, females have higher mean scores on five of the six items in the Issues Awareness subscale (under-representation of females, gender equity research, interaction patterns favoring females and males, and inclusive language patterns). On the Formal Education subscale, females reported more extensive coverage of three of the topics (curricular evaluation, equity legislation, and classroom environments) and males reported more extensive coverage of the other three (observation techniques, instructional strategies, teaching resources) at the conclusion of the class. None of the differences in the means were large.

Table 4 provides similar information on the means and standard deviations by each item reported by years of experience of the teacher. For the Issues Awareness subscale in the pre-survey, the teachers with less experience reported more awareness of three areas (gender equity research, interaction patterns favoring males, and science gender stereotypes), while the teachers with more experience reported more awareness of gender equity research, interaction patterns favoring females, and inclusive language patterns. The means in the post-survey results show similar differences for four of the items, however, at the conclusion of the course, the less experienced teachers show a greater awareness of the issue of under-representation of females and the more experienced teachers show a greater awareness of the issue of science gender stereotypes. The more experienced teachers reported more previous formal education in four of the six items on the pre-survey (curricular evaluation, teaching resources, equity legislation, and classroom environments). At the conclusion of the course, these teachers reported less exposure to information on equitable classroom environments than the less experienced teachers and more exposure to all other items. Similar to the results reported by gender, the differences in the means of these groups were small.

Table 4. Mean values for each item on pre- and post-survey by years of teaching experience.

| | | Pre-survey | | | | Post-survey | | | |
|---------------------------|---------------------------------------|--------------------------------------|------|--|------|--------------------------------|------|----------------------------------|------|
| | | 10 or less years of experience (N=7) | | More than 10 years of experience (N=6) | | 10 or less years of experience | | More than 10 years of experience | |
| | | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Issue Awareness Subscale | Under-representation of females | 3.00 | 0.58 | 3.17 | 0.75 | 3.71 | 0.49 | 3.67 | 0.52 |
| | Gender equity research | 2.14 | 0.90 | 1.83 | 0.41 | 3.57 | 0.53 | 3.50 | 0.55 |
| | Interaction patterns favoring females | 2.00 | 0.82 | 2.17 | 0.41 | 3.00 | 1.00 | 3.33 | 0.52 |
| | Interaction patterns favoring males | 2.43 | 0.98 | 2.33 | 0.52 | 3.43 | 0.53 | 3.33 | 0.52 |
| | Science gender stereotypes | 3.29 | 0.76 | 3.00 | 0.63 | 3.57 | 0.53 | 3.83 | 0.41 |
| | Inclusive language patterns | 2.57 | 0.79 | 2.67 | 0.82 | 3.14 | 1.07 | 3.67 | 0.52 |
| Formal Education Subscale | Observation techniques | 1.57 | 0.53 | 1.33 | 0.82 | 3.43 | 0.79 | 3.67 | 0.52 |
| | Instructional strategies | 1.71 | 0.95 | 1.67 | 0.82 | 3.29 | 0.49 | 3.67 | 0.52 |
| | Curricular evaluation | 1.29 | 0.49 | 1.50 | 0.84 | 3.29 | 0.49 | 3.50 | 0.55 |
| | Teaching resources | 1.14 | 0.39 | 1.33 | 0.82 | 3.29 | 0.49 | 3.33 | 0.52 |
| | Equity legislation | 1.57 | 0.79 | 1.67 | 0.82 | 2.86 | 0.69 | 3.33 | 0.82 |
| | Classroom environments | 1.29 | 0.49 | 1.67 | 0.82 | 3.66 | 0.47 | 3.50 | 0.55 |

Instrument: Qualitative. The first open-response question asked the teachers to provide their definition of gender equity. Nine of the thirteen participants defined this term using some version of the phrase “equality of opportunity” in the pre-survey and kept their responses substantially the same in the post-survey, with three of the nine providing additional clarification. The other four teachers (two females with more than 10 years of experience and two males with less than 10 years of experience) defined gender equity as “equal treatment” of students regardless of gender in the pre-survey. All of these students changed their responses in

the post-survey to reflect the more complicated process of equitable teaching, including providing “equal opportunities,” “fair treatment,” curriculum and teaching with “minimal bias,” and the “best education for all.”

The second open-response question asked the teachers to describe themselves as a teacher that promotes gender equity in the classroom. The responses from the pre-survey revealed that many of the teachers were aware of equitable practices relating to student-teacher interactions, female role models in science, and instructional strategies such as single- and mixed-sex grouping and assigning classroom tasks. The responses to the post-survey reflected further knowledge of these issues and also included additional strategies in the areas of language use and equitable curricular materials.

Discussion

The results reported in the previous section indicate that the teachers in the gender equity course gained knowledge about gender issues in education as a result of the course. Since knowledge gain on course content is an expected outcome, the statistical results of post-surveys administered at the close of the course may not be very enlightening. However, several anecdotal remarks substantiate the quantitative results, providing an indication of the potential for the application of the knowledge gained and for meaningful impact in the longer term.

While researching topics for their biographies on women scientists, many students found it difficult to locate appropriate resources in their school and community libraries. A female teacher with 10 or less years of experience commented, “When I was originally given the assignment, I thought: ‘No problem! I’ll just visit my school library and have dozens to choose from.’ Boy was I wrong!” Another male teacher with 10 or less years of experience commented that “It was exciting just to know that there are more women scientists out there than I thought.”

Concrete improvements that resulted from the biography project assessment include both public and private actions. One teacher with 10 or less years of experience indicated in his journal that after this project, “I want to read more biographies of scientists. This is one of my projects for this summer.” Several other teachers recommended specific books to their school media specialists for purchase.

In commenting on her lack of previous exposure to gender equity issues, one teacher with 10 or less years of experience commented, “I realize cultural and gender inequities are very similar struggles on the social front...[but] no one ever taught me how to confront school gender issues. But I can remember very early in my educational experience being taught about racial inequities.” These comments parallel the low-level of gender equity knowledge found by Plucker (1996) in in-service science teachers. After completion of this course, the teachers in this study demonstrated a greater depth of effective strategies and knowledge of the issues surrounding gender equity in science education.

Many teachers showed growth of understanding as they reflected on viewing the videotapes of their teaching. Some were simply unaware of the patterns occurring in their classrooms, such as “I was surprised and appalled at the huge discrepancy” in interactions with females and males, a comment from a female teacher with more than 10 years of teaching experience. Some began to realize how complex student-teacher interactions are when viewing them through a lens of gender studies. One commented, “I wonder how fair evaluating gender in my classroom is when I have 9 very eager and capable girls and 11 very rowdy boys. Surely that inequality in itself would make a difference in my data. But, I guess personality shouldn’t be a major factor when deciding how fair a classroom is for boys and girls” (female teacher with 10 or less years of experience). Another lamented that “the behavioral composition of the male

students [ADHD-diagnosed] somewhat dictates my attention and is needed more often for the boys” (female with more than 10 years of experience).

Similar to the results found by Ambrosio et al. (1991), the evaluation of this gender equity pilot course showed that the course was successful in raising the awareness of the participating teachers about key issues relating to gender and science education. One female with 10 or less years of experience noted that, “This class is really useful for me to evaluate my teaching style” as it relates to gender issues. Further research to assess whether or not this increased awareness will increase the participation of females in the physical sciences in the long-term is needed.

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