Gender equity in science classrooms: are teachers providing the necessary adjustments to meet the needs of female students?

Rachel Alexander
Gender Equity in Science Classrooms-
Are Teachers Providing the Necessary Adjustments to
Meet the Needs of Female Students?

Master's Project

Submitted to the Faculty
Of the Master's of Science Program in Secondary Education
Of Students who are Deaf or Hard of Hearing

National Technical Institute for the Deaf
ROCHESTER INSTITUTE OF TECHNOLOGY

BY

Rachael Alexander

In Partial Fulfillment of the Requirements
For the Degree of Master of Science

Rochester, New York

May 8, 2000

Approved

(Project Advisor)

(Program Director)
Abstract

Boys and girls often exhibit different approaches to learning and have different learning styles. This research project examines high school science teachers’ knowledge of these differences and their willingness to incorporate a variety of strategies into their teaching to help ensure the educational success of their female students. A survey was developed and mailed to the state schools for the Deaf across the country and to public schools in the Rochester, New York area. The survey, directed towards science teachers in high schools, asked specific questions regarding the manner in which information was delivered in the classroom, while also asking how willing the teachers were to making changes in their instructional delivery in order to enhance the learning opportunities for their female students. Results of this survey indicated that many of the teachers were aware of strategies that help to facilitate female students participation and learning in the classroom. Most teachers, who were unaware of the strategies and their impact on facilitating participation and learning, could see that the strategies were valuable tools and would incorporate them in to their lessons in the future. These factors considered, one might be encouraged that with increased knowledge of learning style differences and incorporation of new instructional techniques, girls might find greater success and confidence in the science classroom which would carry over to educational and career choices in the science field.
Introduction

Women are traditionally underrepresented in the science field. This reduction in potentially qualified professionals serves to hinder the field of discovery in the scientific and technological realm. It is imperative that research be done to determine ways to encourage interest and success in girls, who enter grade school at an educational and developmental advantage over boys, but lose this edge in junior high school. Research into the teaching methods and attitudes of instructors in science classrooms could serve to help educators gain insight in ways to encourage participation and instill a sense of confidence in female students in science classes. If teachers were found to be unaware of the learning differences between male and female students, then perhaps simply drawing attention to their needs could improve female participation in class, which may lead to a change of opinion regarding science as a career option.

A research study on teachers' methods of instruction and attitudes toward accommodating all learning styles would help us understand the degree of conscious or unconscious gender bias that may be taking place within American high school science classes. It is reasonable to surmise that such bias could negatively impact female students' opinions of careers in science. If it is found that teachers themselves are not contributing to the poor educational successes and confidence of female students, then we must look for some other internal or external force responsible for the limited number of women that go on to pursue education and careers in the science field.

Results from a study such as this could be used in teacher training seminars to alert future teachers and veteran teachers to the fact that not all students learn in similar
manners and that specific, easy to incorporate tactics could improve the rapport and participation of all students in the classroom. Education programs for colleges could also incorporate this information into classes that teach about learning styles and gender bias.

This paper discusses some of the literature and research that has previously addressed the subject of gender bias in the science classroom. The methods section explains the intent of the study, including topics and questions addressed. Participants of the study and the procedures used for data collection and analysis are also described in the methods section. The results section includes a summary of the data collected and the results of the analysis. Discussion related to the use of the results is the final section the paper, with references and appendices attached.

Literature Review

This section is divided into the following areas: history of gender inequality in education, how teacher interactions can influence gender inequality, how adolescence changes girls, ways to avoid gender bias in the classroom specific to science education and general education, and concludes with the effects of an all-girls academic setting. The research and informal information that is available on these subjects sheds light on how the changes that a girl experiences as she goes through adolescence impacts her educational needs. The information also highlights the specific educational needs that girls have, as well as discussing strategies that teachers can incorporate into their instruction.

History of Gender Bias in Education

The medical and scientific communities have historically looked upon women with wonder, curiosity and concern. The view of women as being something other than
“normal” has adversely affected their educational opportunities. The article, “Gender equity: Still knocking at the classroom door” by David Sadker (23-24, 1999), explores some of the myths that surround the history of women in education. In his article he says,

One hundred years ago, the argument against female education centered on health. Doctors warned that education redirected blood initially destined for the ovaries to the brain. The result: Educated women would be less likely to reproduce and more likely to go insane. The doctors’ prescription: Keep girls out of school.

For many years girls had very limited educational opportunities and certainly were not encouraged to pursue anything other than the typically female roles in life. With the enactment of Title IX in 1972, which mandated that no student be denied the opportunity to participate in educational programs that receive government funding based on their gender, new experiences and possibilities should have been opened up to girls. Today, Title IX is primarily applied to the area of participation in sporting events. Girls now have access to participation in the full range of sports and must have the same accommodations as male athletes. The once sex-segregated military institutions have opened their doors to females as well. The Virginia Military Institute and the Citadel have admitted women to their learning institutions, “however the course of study and careers remain gender-specific” (Sadker, p.23, 1999). So while the law states that a student cannot be denied the right to participate in an educational program that receives
government funding, the specific concentrations or programs in which students enroll is not regulated. The courses taught and made available to the students are up to the decision of the schools themselves. Policies exist that have eliminated sexual discrimination from the education arena, but remnants and side effects remain. The stigma continues to be seen in vocational/technology related courses that are available to both sexes. The enrollment of female students in such programs is at an all time low.

A significant resource to the teacher who is unfamiliar with gender equity issues is available on-line at, “Beyond Title IX: Gender Equity Issues in Schools”, found at: http://www.maec.org/beyond.html. This site was developed under a grant from the Department of Education and contains information on the history of Title IX, its effects on the educational design of schools, how Title IX relates to bias found in teacher/students interactions, the participation and achievement of girls in math and science courses, and self-esteesms issues that girls experience.

**The Influence of Teacher/Student Interactions**

The rapport that teachers have with their students sets the tone for the quantity and quality of learning that is achieved in the classroom. The influence of student/teacher interactions was addressed in a paper presented by Barbara N. Martin at the 8th Annual National Conference on Creating the Quality School in Memphis, Tennessee. Her descriptive study using observations, interviews, and surveys was conducted in five rural secondary schools in Missouri. The researcher spent time with the students and the teachers, gleaning information and stories that would either support or refute her idea that gender bias exists in the modern classroom. She found through direct observations that teacher/student interactions were overwhelming in favor of the male students, although
neither the students nor the teachers themselves felt that way. The language used during
the interactions did not support a gender bias but “the fact that the male students received
more attention from teachers continues to perpetuate the stereotype that male have more
worth than females” (Martin, 1999, p.9).

In the Martin study, males were given more attention than females and typically the
attention was more positive than negative. It was also noted that the teachers asked more
high-level questions of the boys, therefore implying higher expectations of the abilities of
the boys than the girls. It followed that because there are more teacher/male student
interaction, there was more participation on the part of the male students in the
classrooms.

Finally, the instructional materials used in the classrooms were examined by Martin
and found to be gender equal and with current copyright dates. Martin pointed out that
schools that have budget restraints and therefore must use older texts and materials will
need to find ways to compensate for their portrayal of women, or lack of their portrayal
of women, in the texts they must use in their instruction.

The findings from the Martin study are supported by the on-line website noted
previously “Beyond Title IX: Gender Equity Issues in Schools”, which also addresses the
issue of teacher/student interactions. This site states, “although most teachers believe that
they treat girls and boys the same, research indicates that they frequently do not” (Mid-
Atlantic Equity Center on-line resource, p.5, 2000). The website quoted information
taken from work done by Kahle in 1990 in “What Girls Don’t Know,” a chapter in the
book *What Research Says to the Science Teacher—The Process of Knowing*, to point out
that “although differences among subject matter areas have not been well-examined,
recent research has found student-teacher interaction in science classes to be biased towards boys” (Mid-Atlantic Equity Center on-line resource, p5, 2000). This on-line resource supplies several questions for teachers to ask themselves as a means for judging their interactions with their students and provide suggestions for equally dividing time and attention to both sexes.

Adolescence and Girls

In 1995, Ruth Tschumy wrote the article, “What do we know about girls? Ensuring gender equity in the classroom”. In this article she referred to the work of Sadker and Sadker, on how girls transition into adolescence. “The transition from elementary school to middle school may be the most damaging period of a young girl’s life” (p.58). How is this possible? Research has shown that girls enter school more ready to learn and with better academic skills than boys of the same age. Studies suggest that “girls (more frequently than boys) demonstrate literacy skills (e.g., able to recognize letters of the alphabet) and small motor skills (e.g., able to button own coat) earlier than boys” (Reese, 1997). “This early trend of success and preparedness continues through elementary school with girls chosen for gifted programs in equal or greater numbers than boys” (Sadker, 1999, p 24). However, by the 10th grade the girls drop out of these programs.

A study conducted by the American Association of University Women (AAUW) found that the self-esteem of girls drops drastically as they reach adolescence. “Although at ages 8 and 9, girls are confident and assertive, by the time they emerge from adolescence they have a poorer self-image, less self-confidence about themselves and their abilities, and more limited views about their future” (taken from on-line resource www.maec.org/beyond.html, p.22). This lack of self-esteem and the inability to
understand one’s self-worth negatively impacts the student’s participation and achievement in school. They will no longer pursue challenging courses in math and science because they do not believe they have the ability to be successful.

**Single Sex Classrooms and Equality**

Some supporters of classroom equality suggest that a single sex classroom is the only way to eliminate the overpowering influence that males students have over female students. Such single-sex schools and classes exist and their success has been studied. MaryAnn Martin presented a paper at the Annual Meeting of the National Association of Research in Science Teaching in 1996 titled: “Inside a Gender-Sensitive Classroom: An All Girls Physics Class.” The paper was a summary of her research on an all girls physics class and incorporated the use of reflective journal writing by the teacher-researcher. Martin found that girls needs could be categorized as: “1) celebrating the girls’ strong identity, 2) respecting the girls as central players, 3) developing female appropriate skills and learning strategies, and 4) acknowledging and removing barriers to learning” (p.5). This single-sex classroom arrangement served to boost self-esteem and confidence, while teaching the students in a manner they could relate to, such as teaching about physics using female appropriate examples. Drawing on experiences that the girls encountered regularly and incorporating those experiences into the learning materials made the students more engaged and more willing to participate by asking higher order questions.
Ways to Avoid Gender Bias- Science and General Education

In 1996 the New England Consortium for Undergraduate Science Education created a guide for faculty entitled, “Achieving Gender Equity in Science Classrooms”. The purpose of this handbook, available on-line at:
http://www.brown.edu/Administration/Dean_of_the_College/homepage.../Equity_handbook.htm
is to address the concern of under-representation of females in the field of science and the general improvement of science education. The suggestions that the faculty created apply not only to the college level but also to the high school and junior high level. They include: encourage class participation and allow wait time before choosing someone to answer a question, self-monitor who you call on, encourage the use of study groups, use more writing exercises, and rearrange the classroom setting into a comfortable arrangement such as the U-shape which allows a more personal feeling and sense of connection” (2000, p.6). The handbook also suggests emphasizing the classroom/lab connection, making labs more open-ended to encourage free-thinking, discussing the value of science and applying the materials to everyday experiences, and finally, informing the students of career options in science.

The AAUW also makes suggestions about how the classroom instruction could be changed to support the female students. On their web page found at:
http://www.aauw.org/4000/lessonslearned.html, they state that “Incorporating plenty of hands-on activities and offering girls ample opportunities to manipulate often unfamiliar equipment spurs girls’ enthusiasm for math and science. Internships in science related industries also increase girls’ involvement in math and science” (p.1). More exposure to science career options, opportunities to try equipment prior to the required use, formation of a trusting environment, and encouraging participation through extended wait time are
techniques that could benefit any classroom, at any level of education, but apply specifically to the sciences.

Methods

The goal of this research project was to see if teachers were knowledgeable about and using (or willing to use) “female friendly” learning practices within science classrooms. A survey was designed that asked questions concerning current practices related to teaching strategies and willingness to adopt strategies in the future. See Appendix for a copy of the survey. The survey was sent to 50 state run schools for the Deaf across the country, and to 27 public schools in the Rochester, NY area, including the city and suburban schools. The survey was sent along with a cover letter that directed the heads of the science department at each school, to duplicate as many as needed to supply each teacher in the department with a copy of the survey. A two week waiting period was given for the responses to be returned and then follow up email was sent to schools that had not responded.

The survey itself was designed as a checklist, allowing teachers to choose one answer from four responses to the various questions regarding their opinions or usual classroom behaviors. The responses included the following: “I know this is recommended for female students and I try to follow this in my classroom”, “I did not know this, but it sounds reasonable and I will try it in the future”, “I can see where this might be helpful but I don’t feel it would be appropriate in my classroom”, and finally “Does not seem reasonable and I have no intention of doing this”.
Survey questions included the instructional strategies of: 1) increased wait time between when a question is asked and when a teacher calls on a student for the answer, 2) inclusion of females scientists as examples in lecture, 3) discussing careers in science with female students, 4) assigning female students to leadership roles in the classroom, 5) using females in activities and examples in lectures, 6) The use of instructional activities such as cooperative learning, role playing and team projects, 7) offering test taking skills practice, 8) allowing students to form learning groups in an effort to create a trusting environment, and 9) offering different options for completing the same work (written paper vs. oral report).

Two free response items were also included in the survey: 1) Name an issue that you feel interferes with females achieving optimal learning, and 2) Do you feel gender bias is a problem that exists in schools today. In addition to the teaching strategies and free response items, the teachers were asked to indicate their gender, number of years teaching, the percent of male and female students in a typical class that they teach, and which science courses they teach. At least one response was returned from 17 schools for the Deaf and 9 Rochester area schools for a total of 26 responses.

Data analysis consisted of a descriptive summary of the items responses broken down by schools for the Deaf and Rochester area schools. The free response items were typed verbatim. A summary of all information, including teacher characteristics, responses to the teaching strategies items, and free response items are included in the results section.
Results

A total of 26 teachers responded to the survey (See Table 1). Fifteen of the respondents were female and 11 were male. The largest number of responses came from the schools for the Deaf with 17 responses compared to the Rochester area schools with only 9 responses. Both the schools for the Deaf and the Rochester area school had more female teachers that responded to the survey than male teachers.

Both the Rochester area schools and schools for the Deaf both had the largest number of respondents (56% and 65%) in the category of “Eleven or more Years” of teaching experience. The schools for the Deaf had the least amount of teachers with only beginning experience (12%) proportionate to their number of teachers overall. The second largest grouping of teachers in the schools for the Deaf was in the category of “Five to Ten Years”. While the Rochester area school only had nine teachers that responded to the survey, the majority of their teachers (56%) had eleven or more years of experience. Their next largest group was in the “Five years or less” category (33%), followed by “Five to Ten Years” of experience.

In examining the gender make-up of the classes taught by both groups, it is interesting to note that two-thirds of the teachers from the Rochester area schools reported their classes comprised less than fifty percent boys while teachers from schools for the Deaf reported their classes were almost evenly divided between 50-75% boys (47%) and less than 50% boys (47%) Overall, the teachers responding to the survey appear to have more girls than boys in their classes.
Table 1

Characteristics of Teachers Responding to the Survey

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total Group</th>
<th>Rochester Area Teachers</th>
<th>Schools for the Deaf Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=26</td>
<td>N=9</td>
<td>N=17</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11 (42%)</td>
<td>3 (33%)</td>
<td>8 (47%)</td>
</tr>
<tr>
<td>Female</td>
<td>15 (58%)</td>
<td>6 (67%)</td>
<td>9 (53%)</td>
</tr>
<tr>
<td>The number of years You have been teaching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than five</td>
<td>5 (19%)</td>
<td>3 (33%)</td>
<td>2 (12%)</td>
</tr>
<tr>
<td>Five through ten</td>
<td>5 (19%)</td>
<td>1 (11%)</td>
<td>4 (24%)</td>
</tr>
<tr>
<td>Eleven or more years</td>
<td>14 (54%)</td>
<td>5 (56%)</td>
<td>11 (65%)</td>
</tr>
<tr>
<td>The percentage of Boys vs. girls in courses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usually 75% or more boys</td>
<td>1 (4%)</td>
<td>0</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Usually 50 to 75% boys</td>
<td>11 (42%)</td>
<td>3 (33%)</td>
<td>8 (47%)</td>
</tr>
<tr>
<td>Usually less than 50% boys</td>
<td>14 (54%)</td>
<td>6 (67%)</td>
<td>8 (47%)</td>
</tr>
</tbody>
</table>

Responses to the objective survey items number one through nine are summarized in Tables 2 through 4. Initially the responses were examined for the whole group (Table 2), and then separated into responses from schools for the Deaf (Table 3) and the Rochester area schools (Table 4). Table 2 summarizes answers to the survey questions as a collective group.
Table 2

Teacher Responses to Objective Survey Items

<table>
<thead>
<tr>
<th>Activity or Behavior</th>
<th>Try to do</th>
<th>Will Try in Future</th>
<th>Not Appropriate For My Class</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Adjust Wait time” between question and calling on students. I wait a few seconds</td>
<td>9 (34%)</td>
<td>11 (42%)</td>
<td>4 (15%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>and calling on students. I wait a few seconds before calling on female students</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make a special effort to include female scientists in my lectures.</td>
<td>21 (81%)</td>
<td>3 (12%)</td>
<td>1 (4%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Make a special effort to talk about careers in science to my female students.</td>
<td>24 (92%)</td>
<td>1 (4%)</td>
<td>0</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Go out of my way to assign females in leadership roles on science project teams and</td>
<td>18 (69%)</td>
<td>4 (15%)</td>
<td>4 (15%)</td>
<td>0</td>
</tr>
<tr>
<td>other cooperative projects.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go out of my way to use females and female activities in the examples I use in my</td>
<td>14 (54%)</td>
<td>5 (19%)</td>
<td>5 (19%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>lectures.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I offer test taking skills practice.</td>
<td>19 (73%)</td>
<td>4 (15%)</td>
<td>2 (8%)</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>I allow students to form learning groups in an effort to create a trusting</td>
<td>21 (81%)</td>
<td>2 (8%)</td>
<td>3 (12%)</td>
<td>0</td>
</tr>
<tr>
<td>environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use instructional activities that girls find Particularly enjoyable (such as</td>
<td>22 (85%)</td>
<td>2 (8%)</td>
<td>2 (8%)</td>
<td>0</td>
</tr>
<tr>
<td>cooperative learning, role playing, and team projects), regularly in my instruction.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I offer different options to students for completing the same work ( written paper</td>
<td>23 (88%)</td>
<td>2 (8%)</td>
<td>0</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>vs. oral report).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Responses to question one: “Adjust wait time” between asking a question and calling on students for an answer had the most responses of “will try to do in the future”, with a total of eleven teachers (42%) selecting that answer and nine teachers (34%) saying that they currently use this technique in their classroom. Four teachers (15%) felt that the strategy was not appropriate for their class, while two teachers (8%) felt that it was not reasonable and had no intention of trying it in the future.
Responses to Question Two: “Make a Special effort to include female scientists in my lecture” showed that most teachers are already incorporating this strategy into their teaching methods. A full 81% percent of the teachers reported that they already use this in their instruction and 12% percent said that although they had not done so in the past they would now consider using this approach. An equal amount of respondents said that they felt that the strategy was not appropriate for their class and had no intention of ever doing so in the future.

Question number three asked the teachers to examine their instructional methods and determine if they made a special effort to talk about careers in science with their female students. Ninety-two percent of all teachers who responded to the survey, said that they currently do so during their instruction time. One person said they would try to do so in the future and none said that it was not appropriate for their courses. One person said they disagreed with the use of this practice and therefore had no intention of trying it in the future.

The fourth question asked whether or not teachers go out of their way to assign females to leadership roles on science project teams and other cooperative projects. Once again, the majority of teachers that responded to the survey (69%) said they currently were using this strategy in the classroom. An equal percentage of teachers (15%) said that they will try this in the future, while another 15% said they did not feel it was appropriate for their class. None of the teachers said that they did not think it was a valid strategy.

Question five asked teachers if they used females in their examples for science concepts that are presented in class. Fifty-four percent of all teachers who responded said that they did use females in the examples they presented during lectures. Nineteen
percent of the teachers said that they would try to incorporate this into their lessons, and another 19% of teachers felt that this strategy would not be appropriate for use in their classrooms. Two teachers completely disagreed with the strategy and refused to consider it for their students.

The sixth question asked whether or not teachers offered test taking skills practice for their students. The majority of teachers said that they currently do offer such a practice for their students, and fifteen percent said that they did not currently offer test taking skills practice but that they would try to do so in the future. Eight percent did not feel that it would be appropriate for their classes and four percent said they did not agree with the use of such a strategy and had no intention of trying it in the future.

Question seven asked teachers whether or not they allow their students to form learning groups in an effort to create a more trusting environment in the classroom. The majority of the teachers (81%) responded that they already were doing this in their classrooms. The next largest percentage of teachers (12%) said that they did not feel that this would be appropriate for their classroom, and eight percent said they would try this method in their classroom in the future.

The incorporation of instructional activities that female students find appealing, such as cooperative learning, team projects, role-playing, etc, was the basis for question eight. Most teachers (85%) said they currently used this strategy. An equal number of teachers (8%) said they either would try to use this in the future or that they did not feel it was appropriate for their class. None of the teachers said that they felt it was not a reasonable strategy.
The final question asked if teachers offered different options for completing the same work, such as handing in a written paper instead of doing an oral report. Eighty-eight percent of the teachers said they currently offer this to their students. Four percent said they did not agree with this method of instruction and would not use it, while eight percent said they would try it in the future.

These same questions were summarized separately for teachers from at Rochester, NY area schools and the state schools for the Deaf across the country. Table 3 looks at the responses given by the teachers from the Rochester area schools.
Table 3

Teacher Responses to Objective Survey Items
Rochester Area Schools
N=9

<table>
<thead>
<tr>
<th>Activity or Behavior</th>
<th>Try to do</th>
<th>Will Try in Future</th>
<th>Not Appropriate For My Class</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Adjust Wait time&quot; between question and calling on students. I wait a few seconds before calling on female students</td>
<td>3 (33%)</td>
<td>5 (56%)</td>
<td>1 (11%)</td>
<td>0</td>
</tr>
<tr>
<td>Make a special effort to include female scientists in my lectures.</td>
<td>7 (78%)</td>
<td>1 (11%)</td>
<td>1 (11%)</td>
<td>0</td>
</tr>
<tr>
<td>Make a special effort to talk about careers in science to my female students.</td>
<td>8 (89%)</td>
<td>1 (11%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Go out of my way to assign females in leadership roles on science project teams and other cooperative projects.</td>
<td>2 (22%)</td>
<td>2 (22%)</td>
<td>1 (11%)</td>
<td>0</td>
</tr>
<tr>
<td>Go out of my way to use females and female activities in the examples I use in my lectures.</td>
<td>4 (44%)</td>
<td>2 (22%)</td>
<td>3 (33%)</td>
<td>0</td>
</tr>
<tr>
<td>I offer test taking skills practice.</td>
<td>9 (100%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I allow students to form learning groups in an effort to create a trusting environment.</td>
<td>6 (67%)</td>
<td>1 (11%)</td>
<td>2 (22%)</td>
<td>0</td>
</tr>
<tr>
<td>Use instructional activities that girls find Particularly enjoyable (such as cooperative learning, role playing, and team projects), regularly in my instruction.</td>
<td>7 (78%)</td>
<td>0</td>
<td>2 (22%)</td>
<td>0</td>
</tr>
<tr>
<td>I offer different options to students for completing the same work (written paper vs. oral report).</td>
<td>8 (89%)</td>
<td>0</td>
<td>0</td>
<td>1 (11%)</td>
</tr>
</tbody>
</table>
Table four examines the same questions and the responses from the teachers at the schools for the Deaf.

Table 4

<table>
<thead>
<tr>
<th>Activity or Behavior</th>
<th>Try to do</th>
<th>Will Try in Future</th>
<th>Not Appropriate For My Class</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Adjust Wait time&quot; between question and calling on students. I wait a few seconds before calling on female students</td>
<td>6 (35%)</td>
<td>6 (35%)</td>
<td>3 (18%)</td>
<td>2 (12%)</td>
</tr>
<tr>
<td>Make a special effort to include female scientists in my lectures.</td>
<td>14 (82%)</td>
<td>2 (12%)</td>
<td>0</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Make a special effort to talk about careers in science to my female students.</td>
<td>16 (94%)</td>
<td>0</td>
<td>0</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Go out of my way to assign females in leadership roles on science project teams and other cooperative projects.</td>
<td>12 (71%)</td>
<td>2 (12%)</td>
<td>3 (18%)</td>
<td>0</td>
</tr>
<tr>
<td>Go out of my way to use females and female activities in the examples I use in my lectures.</td>
<td>10 (59%)</td>
<td>3 (18%)</td>
<td>2 (12%)</td>
<td>2 (12%)</td>
</tr>
<tr>
<td>I offer test taking skills practice.</td>
<td>13 (76%)</td>
<td>3 (18%)</td>
<td>0</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>I allow students to form learning groups in an effort to create a trusting environment.</td>
<td>14 (82%)</td>
<td>2 (12%)</td>
<td>1 (6%)</td>
<td>0</td>
</tr>
<tr>
<td>Use instructional activities that girls find particularly enjoyable (such as cooperative learning, role playing, and team projects), regularly in my instruction.</td>
<td>14 (82%)</td>
<td>2 (12%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>I offer different options to students for completing the same work (written paper vs. oral report).</td>
<td>14 (82%)</td>
<td>2 (12%)</td>
<td>1 (6%)</td>
<td>0</td>
</tr>
</tbody>
</table>
Both of these tables show that the majority of the teachers currently are using the strategies that girls seem to require to reach their full academic potential in the sciences. The schools for the Deaf had more responses that stated that they disagreed with the various strategies and had no intention of ever using them in their classroom. Of the nine questions asked, the schools for the Deaf had at least one response in the category stating they disagreed with the strategy for five of those nine questions. The Rochester area schools only had one response to those nine questions that said they would not use that strategy in their classrooms.

Another area of difference between the two groups was found in the responses to the item about adjustment of wait time between when a question is asked and when the teacher calls on a student for the answer. In schools for the Deaf the majority of teachers were not currently providing adequate wait time for their students, while Rochester area schools were split equally in number between those teachers that were currently providing adequate wait time to their students and those that were not doing so currently, but planned to try to in the future.

Still another area of difference is the number of teachers that provide test taking skills practice to their students. In the Rochester area schools, 100% of the teachers currently offered this service to their students. At the schools for the Deaf, 76% percent were doing this currently and six percent said they did not feel that the strategy was appropriate and had no intention of trying it in the future.

Teachers at schools for the Deaf reported they were more likely to include instructional activities that girls tend to find stimulating and enjoyable such as cooperative learning, team projects, and role-playing. This is also true of the number of
teachers in schools for the Deaf who allow their students to form learning groups in an effort to create a more trusting environment as compared to the numbers for the Rochester area schools.

A final area of difference is in the number of teachers at the schools for the Deaf who reported that a particular strategy was not appropriate for their classroom. Of the nine strategies included in this survey, at least one respondent from schools for the Deaf indicated eight of these strategies were either not appropriate for their classes or they disagreed with the strategy. The Rochester area school teachers had fewer responses in those two categories. More teachers in the Rochester area schools chose to say that a particular strategy or method was not appropriate for their class rather than say that they disagreed with the use of such a strategy altogether. The schools for the Deaf had an even number of teachers who picked both the reply that the strategy was not appropriate for their class or they disagreed with the strategy and would not use it in the future.

Responses to the free response questions were collected and are listed in Tables Five and Six. The responses were listed verbatim to preserve the integrity of the statements. Table five details the responses to the statement, “Name an issue you feel interferes with females achieving optimal learning”.
Table 5
Free Response Questions Part 1
N=19

Question:
Name an issue you feel interferes with females achieving optimal learning

<table>
<thead>
<tr>
<th>Rochester Area Schools- Male Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Boys and making excuses for lack of achievement.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rochester Area Schools- Female Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Stereotyping of female learning, social behavior, and media.</td>
</tr>
<tr>
<td>3. Lack of self-confidence and the message from society that finding and staying with &quot;a man&quot; is more important than school success.</td>
</tr>
<tr>
<td>4. Sexual harassment from male students.</td>
</tr>
<tr>
<td>5. Females are not as vocal as males- may be ignored.</td>
</tr>
<tr>
<td>6. Most girls are quieter and defer to the males in class.</td>
</tr>
<tr>
<td>7. Middle school is often difficult for boys and girls because learning often takes a back seat to socialization.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Schools for the Deaf- Male Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Sexist older male and female classroom teachers and television.</td>
</tr>
<tr>
<td>10. The teachers' biases.</td>
</tr>
<tr>
<td>11. No issue really!! Females and Males equaled to 50%/50%, no discrimination.</td>
</tr>
<tr>
<td>12. Teachers’ attitudes</td>
</tr>
<tr>
<td>13. Home or parent non-involvement or not considering education essential.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Schools for the Deaf- Female Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. Not given the opportunity to share their ideas or thoughts. Females tend to wait to be asked where males will just say what they are thinking even if it is wrong.</td>
</tr>
<tr>
<td>15. I see male students taking a leadership role during laboratory activities. I have separated the labs (boys labs) (girls labs). I see a big difference in the female students.</td>
</tr>
<tr>
<td>16. I feel expectations are higher for males in science and math. I have seen some improvement with this issue.</td>
</tr>
<tr>
<td>17. Females have a different learning style than males.</td>
</tr>
<tr>
<td>18. Peer pressure and self-esteem</td>
</tr>
<tr>
<td>19. Some cultures do not support female students' academics s they do males.</td>
</tr>
</tbody>
</table>
Five of the nineteen responses to this question stated that teachers’ bias contributed to the prevention of females achieving optimal learning. Two of the nineteen statements made reference to boys interfering with females’ ability to participate equally in class. Five of the statements make reference to the submissive nature of girls and how that impacts optimal learning. Comments were made about stereotyping of girls, the role of media, and home involvement that all contributed to the limiting of female learning were found in six of the nineteen responses. Only one response stated that there were no problems related to achieving optimal learning for girls.

Table six summarized teacher responses to the item asking them if they felt that gender bias was a problem that still exists in schools today. Twenty-four responses were given. Seven of the twenty-four respondents said that gender bias still exists today, with many of those respondents qualifying their answer by saying that the problem is not as intense as it was years ago. There were several teachers that said there may be some bias that exists but it depends on a variety of factors such as class, teacher or home influence, sports, and grade level. Six of the respondents said that they did not believe that gender bias was an issue in schools today. Two stated that it might be an issue. Three stated that they did not believe it was an issue in their high school or in their classes but it might be elsewhere- in sports, other grade levels or in other types of schools.
Table 6

<table>
<thead>
<tr>
<th>Question</th>
<th>Free Response Questions Part 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=24</td>
<td></td>
</tr>
</tbody>
</table>

**Do you feel gender bias is a problem that exists in schools today?**

**Rochester Area Schools- Male Teachers**

1. Yes, which is why it is important to be cognizant of the situation.
2. Yes, as a carry over from the past, e.g. cheerleading and its implicit subordinate relationship to boys’ teams.
3. Yes, but it is not as much of a problem at the sixth grade – middle school level. It is more of a problem in high school.

**Rochester Area School-Female Teachers**

4. Depends on the teacher and how sensitive he is to the issue.
5. Yes!
6. No.
7. No, I feel our school district strives to avoid gender bias in all subject areas.
8. To an extent
9. Yes, I am sure educators unconsciously treat females differently than males in the classroom. (Again we have all subconsciously received messages from society that girls have different goals in life)

**Schools for the Deaf-Male Teachers**

10. Not in my school. In the classroom all students are treated equally. Your questions and responses are somewhat biased.
11. More so in the society outside our schools. Females in school environments today are empowered to let cultural gender bias affect them with much consequence.
12. Yes, but less now than five years ago.
13. I doubt that it exists in high schools. Probably in elementary or junior high school.
14. NO!
15. Yes, I think this problem has been reduced.
16. Not that I have observed- my students feel that the only gender bias is in sports, not in academics

**Schools for the Deaf- Female Teachers**

17. Yes.
18. Boys sports are given more emphasis still. Academics are not recognized.
19. Yes, I think it is better than it was 15 or 20 years ago, but it still exists today. I feel some classes would be better if students were separated or based on gender.
20. Somewhat, more in the physical sciences and math than the biological science.
21. Not really- my children are in high school and they are not experiencing any biases that they are aware of.
22. In hearing school-yes, in a deaf school it is less of a factor because the degree of communication at home is the determining factor, whether it be male or female.
23. Yes.
24. I believe it is more of a personality bias than a gender one. Those with outgoing personalities, whether male or female, tend to be rewarded.
Discussion

Data gathered from the survey results indicate that the majority of teachers, in both study groups, are currently using many appropriate strategies to ensure that their female students have access to optimal learning within the science classroom. While female students do demonstrate a different learning style as compared to their male peers, teachers who responded to this survey appear to be attempting to meet those different needs.

One of the most crucial instructional practices that teachers should adopt for their female students is the “adjustment of wait time” between when a question is asked and when the teacher calls on students. High school age girls often take a passive back seat to boys in high school science and mathematics due to the boys’ more dominant nature. If teachers wait an extra second or two before calling on a student to answer a question, it is likely that more girls will think the question over, feel more confident, and therefore raise their hand to volunteer an answer. One-third of teachers said that they currently are practicing this method in their classroom, and two-thirds of those that stated they were not doing so currently did indicate they felt it was a suitable practice and would try to incorporate it into their teaching in the future. Perhaps being more aware of the less aggressive nature of the female student, more teachers will provide their students with more “think time” and therefore will obtain more willing and active participation from their female students.

Another area of great concern is in the incorporation of female role models in classroom lectures and examples. The use of role models gives students concrete examples of those who have become successful, and can be admired or looked up to. This
should be incorporated into every classroom, Deaf or hearing, in which minorities have typically been underrepresented in the subject matter. If a teacher creates an example in science class to demonstrate a problem it is just as easy to say, “Jane rode on a train traveling…” as it is to say, “Johnny rode on a train that traveled.”. Three-fourths of the teachers who responded to the survey said that they currently used this practice in their classroom. This is a positive sign, which indicates that teachers are aware that there needs to be equality with the examples used in their lectures.

Twenty-five percent of the teachers responding said that they were not using females in their examples. These teachers said either that such a practice was not appropriate for their classroom or that they disagreed with the use of this practice. It would be interesting to learn why these teachers are not in favor of this practice. Perhaps they do not see how it applies to their subject area, or why it might enhance female learning. It is possible that they did not understand the question as it was worded. Supplemental examples to support the strategy would have helped to prevent any possible misunderstandings.

If teachers assign their female students to leadership roles on projects in the classroom, both male and female students could benefit from that experience. The female students would gain from having the opportunity to express themselves and take charge of a group. The male students would see the females in a role that was not as the passive assistant, but rather as the dominant and competent manager. Both sides would come away from the situation with a new perspective and respect for the other. While most of the teachers said they were currently assigning leadership roles to their female students, and many of those who were not doing so felt it was valid and would try in the future, a
large portion overall (15%) said they did not feel it was appropriate for their class. While some of the classes had a relatively low number of male students in their class, there is no reason why all students, male or female, should not have the opportunity to manage and lead a group. It is a valuable experience that provides a taste of cooperative, team building skills that are required for the work force.

A final important area is that of providing students with alternative methods of demonstrating mastery of the same work. For example, giving students the option of turning in a written paper instead of doing an oral report. Many girls feel a social pressure during high school and are very self-conscious and experience adverse affects from peer pressure. Forcing students, male or female to reach outside of their comfort zone may be beneficial at times, but to make this a continuous event can only lead to feelings of resentment and dislike of the subject or class. Providing students with an opportunity to "pass" on presenting an oral report allows the student to convey the same information in a manner in which they are comfortable, and have an opportunity to fully demonstrate their knowledge of the subject matter, while not being judged by their public speaking skills. The majority of the teachers stated that they currently provide this option to their students. It is the hope of this researcher that those teachers who had not previously thought of offering such an option to their students might consider the merits of this strategy in the future.

The first free response question asked teachers to name an issue that they felt interfered with females achieving optimal learning. It is interesting to note that the responses form the male teachers focused on teachers’ biases and the nature of boys in general, while the responses from female teachers indicated that the girls themselves
were responsible for their own limitations and that society also contributed to how females perceived themselves and the importance of education versus socialization. It may be speculated that the teachers chose the responses that they did based on personal experiences with their own education growing up, and on observations of their students over the course of their careers.

The second free response question asked teachers if they felt that gender bias was a problem that still exists in schools today. Both male and female teachers from the Rochester area schools indicated that they felt that gender bias was an issue that still exists in schools today, while teachers at the schools for the Deaf indicated that they did not feel that is was an issue. This difference may be due the relatively small number of students in classes at schools for the Deaf, which typically allows for more one to one attention and less female/male behavior differences. One male teacher at a school for the Deaf who had been teaching for over thirty years expressed that he did not feel that gender bias was an issue anymore, but felt that the way the survey questions were designed was biased. Of those teachers who stated that gender bias was an issue, many of them indicated that society played a large role in how people perceive the role of women in education and in culture in general. This perception of woman will naturally carry over, either subconsciously or consciously, into the classroom and will impact how the female student is perceived in the classroom. It is important that teachers are aware that they harbor personal bias within themselves.

It was also interesting to note the differences in the teaching staff at the two groups of schools. While both groups of school had more female than male teachers responding to the survey, the schools for the Deaf had more teachers responding who had
eleven or more years of teaching experience. More of the responding teachers from the Rochester area schools had less than five years of teaching experience. Both of these groups of teachers said the majority of their classes contained more than fifty percent female students. It is possible that the teachers, with their many years of experience and large number of female students, have learned to incorporate the correct strategies to make their students successful into their teaching practice.

Overall, it is promising to note that many of the teachers surveyed are implementing the appropriate strategies to help their female students become successful in the science classroom. Perhaps with increased awareness and attention to female students needs and abilities, more teachers will challenge and engage their students in the science classroom, which will in turn result in increased numbers of females that go on to pursue post-secondary studies in science and careers in science and technology.

Limitations

There were several limitations to this research project. The relatively low number of returns from both groups limited the overall interpretation of the data. It is not appropriate to say that the results that were obtained from this survey represent all schools of the sample groups. Another limitation to the project was in the selection of the groups themselves. The groups were self-selected in that the teachers were free to respond or not respond to the survey and therefore more teachers who felt strongly about the topic or who felt their own use of the appropriate strategies was above average may have chosen to respond.

It is recommended that follow-up research be conducted to either support or refute the findings of this study. Follow-up research might include surveying a larger number of
schools throughout the country, classroom observations of the teachers’ instructional methods, and student interviews. Classroom observations would be a valuable addition to research in this area. Such observational studies could eliminate the possibility that teachers were incorrectly assessing their own teaching styles and practices. It would be interesting to analyze the grades of students who were taught in classrooms that correctly implemented the strategies, and compare those grades to classes in which the teachers were either unaware of the strategies or chose to ignore them. If a significant difference could be found between the two, then that finding would support the need for more awareness and attention to the learning style differences that female students may exhibit.

In addition to classroom observations, sampling a larger number of teachers would provide important information and allow for more sophisticated data analyses. A larger sample would provide a better representation of science teachers in general and would enable a breakdown of the results by teacher gender, years of experience, type of classes taught, etc. This would allow for a more accurate portrayal of teaching practices and possible bias found within science classrooms.

Student interviews should also be included in future studies. These interviews would allow the researcher to better understand the female students’ perception of classroom dynamics. This information could be used to supplement the data and observation of the teachers in action, providing a better overall picture of the classroom on a day-to-day basis.
References


Appendices

Appendix A
Cover Letter for Survey

Dear Science Educator,

As part of my graduate school thesis requirements at the National Technical Institute for the Deaf, I am sending out a survey to the various schools for the Deaf across the country and to the public schools in the Rochester, NY area. My goal is to determine what sort of teaching practices are being used in the science classrooms of high school. My thesis topic focuses on gender equality issues in the science classroom for both Deaf and hearing girls. Please take a moment and fill out the survey that is enclosed and return it to as soon as possible. I would be willing to send you a follow-up handout on gender equitable practices in the classroom if you indicate your interest on the second side of the survey. Thank you for your time and interest in this project.

Please return the survey to:
Rachael Alexander
788 Kimball Dr.
Rochester, NY

Feel free to make as many copies as your department requires. Thank you once again.

Sincerely,

Rachael Alexander
In the past few decades, several research studies have found that female students often perform better under certain circumstances or learning support. Listed below are several behaviors or activities that have been recommended in the research literature. Please indicate your opinions or usual behavior by checking the appropriate line.

<table>
<thead>
<tr>
<th>Classroom Activity or Teacher Behavior</th>
<th>I know this is recommended for female students and I try to follow in my classroom</th>
<th>I did not know this, but it sounds reasonable and I will try it in the future.</th>
<th>I can see where this might be helpful, but don’t feel it would be appropriate in my classroom.</th>
<th>Doesn’t seem reasonable to me and I have no intention of doing this.</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Adjust wait time” between question and calling on student….I wait a few second longer before calling on female students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make a special effort to include female scientists in my lectures.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make a special effort to talk about careers in science to my female students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go out of my way to assign females to leadership roles on science project teams and other cooperative projects.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go out of my way to use females and female activities in the examples I use in my lectures.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use instructional activities that girls find particularly enjoyable (such as cooperative learning, role playing and team projects) regularly in my instruction.</td>
<td></td>
<td></td>
<td></td>
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<td>I offer different options to students for completing the same work (written paper vs. oral report)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please turn the page over for more questions.
Thank you for completing the first part of this survey on the preceding page. Would you now please complete the information below and return the survey in the enclosed envelope:

What courses or courses do you typically teach (subject and grade)?

________________________________________
________________________________________
________________________________________
________________________________________

Your Gender
_____ Male
_____ Female

The number of years you have been teaching
_____ Less than five
_____ Five through 10
_____ Eleven or more years

The percent of boys vs. girls in most of your courses:
_____ Usually 75 percent or more boys
_____ Usually 50 to 75 percent boys
_____ Usually less than 50 percent boys

Free Response:

Name an issue you feel interferes with female achieving optimal learning.

Do you feel that gender bias is a problem that exists in schools today?

Please note: If you would like to receive a summary of the results of this project, please include your name and address below. I anticipate having the project completed in June of 2000. I sincerely thank you for your cooperation.