Gender Equity for Mathematics and Science

Notes on Invited Faculty presentations

Sheila Tobias

The contribution of research to teaching is to help us think about what is being done and how it fits into what we are doing. It is important that she, Sheila Tobias, a researcher, not tell us what to do. We, as teachers, are the experts. The research is out there for us to investigate. We must think about things we have not noticed before. The researchers have investigated the gender issue with the important premise that girls and boys are equal intellectually if left alone. They are, in fact, indistinguishable. When results are otherwise and we reject the hypothesis that there are intellectual differences, then we must find other reasons for the differences. We must replace the notion that women are cognitively disabled. If this notion is rejected, then the differences could be due to socialization. This would mean that the socialization by girls and boys and society's beliefs about them with respect to math and science, are internalized.

The first generation of research explored the **disabling beliefs and behaviors** of females. Beliefs that were uncovered were:

- Math and science disciplines are male domains.
- One has to be a genius in math and science; you have to have a math/science mind.
- You are either good in math/science **or** good in language arts. You can not be good in both. Tobias labeled this the "zero sum" theory. Girls receive positive reinforcement in the language arts because they tend to be more verbal.
- Math/science work is done instantly if at all.
- There is only one right way to do a problem.

The above are internalized and determine the student's behavior.

Learning attribution theory plays an important role. Even when girls succeed, they never take their success with confidence. Girls attribute success to external variables. The chart below explains that when males succeed, they attribute their success to ability and when females succeed, they attribute their success to luck. When males fail, the failure is attributed to not enough effort, and when females fail, the failure is attributed to not enough ability.

	Success	**Failure**
Males	Ability	Not enough effort
Females	Luck	Not enough ability

Math Anxiety

Tobias has done extensive research work on math anxiety. The diagrams below are drawn to be symbolic diagrams of brain functions. With normal cognition, the information is inputted, flowing through the process pathways, and on into the memory pathways of the brain. If the input information encounters emotional overlays, the output memory pathway is harder to reach.

When information is input, girls tend to have lots of emotional overlay so that memory cannot be accessed. She cited Elizabeth Fennema's work concerning autonomous learning behavior: girls are torn between being agreeable, complacent, and feminine as opposed to aggressive, assertive and autonomous. In order to succeed, the latter attributes of aggressiveness, assertiveness, and autonomy are the most desirable. Scientists, on the other hand, require obedience to their demands in their advanced studies.

The Second Generation of Research

The second generation of work explored more classroom conditions. What was found were negative conditions and "chilly climate" issues. She cited the AAUW report based in part on Myra and David Sadker's work on male/female studies with teacher behaviors. Boys tend to get more attention in classrooms than females. She also cited her own work, which studied the belief systems of experts that get in the way of, and cut students off from, their disciplines.

The predominant question still remains, "Who will do math/science?" In her work, Tobias stratified groups of students into categories. The students who traditionally love math/science and usually go on in these fields, she labeled as "us." The rest of the group, she labeled as "them." This latter group can be even further subdivided in tiers. The second tier group are the very verbal group of students who might go on to be lawyers, linguists, political scientists, etc. The next tier are labeled the least focused or "utilitarian," who learn just enough to pass the test, exam, or course. The fourth tier is the "underprepared" and the last group are the "unlikelies," who at times might seem hostile. Our task, as teachers is differentiate among the tiers.

Females are found in all tiers and predominantly in the second tier. Anything we do to improve the quality of math/science must come from a view that women have a right to insist on change. The students in the second tier are both male and female. They have

- high verbal and analytical skills
- strong compare and contrast powers
- common sense and logic
- divergent (as opposed to convergent) thinking skills
- question finding skills
- model sensitivity; what is the model and what is the fact?

Research investigated the perspectives and complaints of students concerning their course work. What they found was that the student perceptions of math/science classes were:

- missing the big picture; students failed to understand how everything fit
- taught in a vertical manner; if the first step was missed then it was difficult to go on
- too fast pace; could not experience the mastery and pleasure to experience and explore; it seemed as if it was a rush to climb the next mountain
- that students were intentionally dropped so that only the elite will continue in math/science
- intellectually barren; the subject was not intellectually stimulating

In terms of noncognitive issues, Tobias shared the findings that the students' perceptions in math/science

classes were:

- highly concerned with feeling "dumb"
- laden with alienation issues such as that these classes are a white male domain; math/science equals mastery and not accommodation of nature, therefore a scientist is like a god and nature is to be mastered; humankind must understand nature and dominate it
- out of control; not areas where they could contribute
- false dichotomies; good in math/science OR language arts but not both
- emphasizing competition and not community; the test curve contributes to this thinking

In order to encourage teachers to attend to the needs of the second tier, Tobias suggested that they construct an enthusiastic support group for math/science. This second tier group of students will be the power brokers in the future. Teachers must gain their confidence.

Exploration of Feelings in Science and Mathematics Classes

After an exercise in trying to solve math puzzles written by her father, Tobias asked that we write our feelings about what we were experiencing while trying to solve each puzzle. The directive was to put yourself as the learner and focus on yourself. Explore your feelings. She cited Polya's seven step method of problem solving; however, this seems to be a top down approach. She is more in favor of a three step approach.

1. Get started by writing it down; draw a picture or diagram (this stimulates the juices to get going).
2. Get unstuck; use any and every method you can think of to help yourself.
3. Be sure that you are right; finish the problem and know when you are finished.

Problem solving is getting inside the problem and figuring out what to do. Floundering can be very creative.

Feelings are very important. We must ask what is making this problem difficult and how can we make this problem easier. This also encourages an assertive behavior. Will power, focus, discipline, and efficiency bring about confidence? Confidence will bring about success, especially in math/science.

More on Math Anxiety

Tobias reviewed the symbolic abnormal cognition diagram of the brain covered earlier. The problem is that, because of math anxiety, the process pathways are filled with "static." The students have learned the material, yet they are unable to retrieve it. Why do colleges and universities continue to remediate freshman students in math classes? A solution to help in this retrieval process of material is to:

- go back and share feelings about math and math classes
- create group bonding
- change the group dynamics from teacher-student centered to student-student centered
- have group-group generated decisions
- learn the math necessary on a "need to know" basis

Tobias also shared the Education Development Corp. film on math anxiety. Students in the film shared some of their concerns with math. There is no one right way to solve a problem!

Strategies

1. Have students fill in the blanks.

   I AM _____IN MATH/SCIENCE.
   I NEED _____IN MATH/SCIENCE.

2. We must start listening to students. Have them write their feelings; write notes; talk into a tape recorder.
3. Triad system:

   (A) teaches (B)
   (C) listens
   (B) must repeat lesson
   (C) critiques before and after

4. *Tracking.* Use tracking to separate the math anxiety students (not intellectually separate them). An example would be the Dalton School in New York City where the math anxiety students are tracked one day a week in a specific class to meet their needs.
5. Have students understand their own learning styles. We have a multitude of styles in our classes. We do not and cannot reach all our students.
6. When students are asked with whom and how often do they talk about the math learned in school, the math anxiety students replies were NO ONE and NEVER.
7. Good math students feel in control and, therefore, do better in the course work. Math anxiety students do not feel in control.

[WW HOME] [MATH] [GENDER EQUITY] [FEEDBACK] [SEARCH]

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