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ABSTRACT

The West Virginia Board of Education is committed by Title IX of the Education Amendments of 1972 and State Policy 4200, "Provision of Equal Opportunity in West Virginia Public Schools," to provide all students with equal access to courses and equal treatment once they are enrolled in those courses. Mathematics, computer technology and science are integral parts of the state's educational programs. This pamphlet provides reviews of research findings related to these three areas and looks at how the factors of gender, early learning, and achievement make a difference in continuing courses in mathematics, computer technology and science. It also addresses information on myths related to female and male students taking mathematics, computer technology and science courses and provides data on female and male students enrolled in these courses as well as other related information. It includes a quiz to help educators evaluate their programs for gender bias. (CW)

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MYTHS AND REALITIES OF STUDENT GENDER AS A FACTOR IN ACHIEVEMENT

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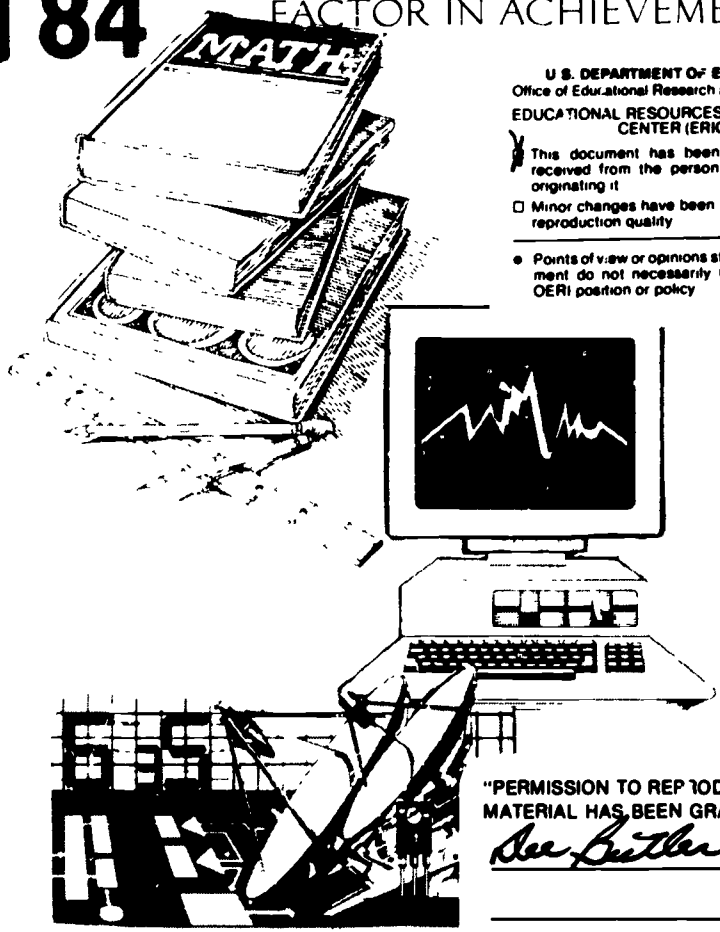

WEST VIRGINIA DEPARTMENT OF EDUCATION

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Mathematics/Computer Technology/Science: MYTHS AND REALITIES OF STUDENT GENDER AS A POTENTIAL FACTOR IN ACHIEVEMENT

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June, 1987

Developed by
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Introduction

> The courses students take in secondary school influence and limit subsequent college and career choices. Most girls, for example, do not go on for advanced science and mathematics classes even if they do well in those subjects. Although there is little difference in the ability of males and females to do mathematics, there is an enormous gap in the numbers that study mathematics. Lacking four years of college-preparatory math, young women find themselves eliminated from many college majors, including astronomy, civil engineering, biochemistry, physics, mathematics, medicine, forestry, economics and computer science.[1]

The West Virginia Board of Education is committed by Title IX of the Education Amendments of 1972 and State Policy 4200, "Provision of Equal Opportunity in West Virginia Public Schools," to provide all students with equal access to courses and equal treatment once they are enrolled in those courses.

Mathematics, computer technology and science are integral parts of the state's educational programs. This book provides reviews of research findings related to these three areas and looks at how the factors of sex, early learning and achievement make a difference in continuing courses in mathematics, computer technology and science. It also addresses information on myths related to female and male students taking mathematics, computer technology and science courses and provides data on female and male students enrolled in these courses as well as other related information.

Should you have any questions after you have reviewed this book or need additional copies of same, please contact Dee Butler, Coordinator for the Elimination of Sex Discrimination Project at 348-7864.

Tom McNeel

Tom McNeel
State Superintendent of Schools
West Virginia Department of Education

I. *Findings Related to Female and Male Students Taking Mathematics, Computer Technology and Science Courses*

> One of the major findings of the National Science Foundation study, *Educating Americans for the 21st Century,* was a direct correlation between the child's early learning experiences and his or her later achievement in mathematics, science and technology. From infancy through early childhood, girls receive subtle and not-so-subtle messages that math, science and technology are male domains. Manipulative and career-oriented toys such as science kits, building games, tools and doctors' kits are directed toward boys. Through words and actions, society sends clear messages as to sex 'appropriate' and 'inappropriate' careers and interests.[2]

Another research finding indicated a lack of empirical evidence to show that there was a gender-related difference in scholastic achievement between girls and boys. However, there was evidence that girls had fewer problems emotionally and physically, girls had more success in reading, were less apt to stutter and matured more quickly physically than did the boys.[3]

In a pilot program for "technical mathematics" in Fayette County Schools, sponsored by the West Virginia Department of Education, the components of mathematics (including algebra I, algebra II, practical geometry and trigonometry) and computer technology (including literacy, application, programming, and problem solving) are taught to all students in grades 9-12. This four-year program was found to have been a factor in the following: (1.) increased test scores on the Comprehensive Test of Basic Skills (CTBS) from an average pre-test score of 60.99 to an average post-test score of 71.88 (a difference of 10.89 points) when a comparison was made of all students who took both tests in all the schools involved in the tech math program in 1985-86; (2.) reducing student dropout rate; (3.) increased enrollment in the Level III Mathematics program which is voluntary; and (4.) increased attendance for the two pilot schools (Fayetteville High School and Midland Trail High School, housing grades 9-12). This mathematics program was recommended by the National Council of Teachers of Mathematics (NCTM) as an alternative course for secondary school mathematics.

In 1984-85, the 9th grade students involved in the two pilot schools took tests in tech math and scored 37 on computation and 39 on concepts and applications (a total score of 38), and the 11th grade students also took tests and scored 53 on computation and 39 on concepts and applications (a total score of 46). Of the 9th grade students participating in the pilot program at Fayetteville High School and Midland Trail High School, 40 percent were females and 60 percent were males.

In the summers of 1985 and 1986, those teachers who would be teaching tech math in other shcools, in addition to the pilot schools, had to participate in week-long training programs. Tech math I was then incorporated into the education programs in five additional schools. A total of 251 out of 344 students were given both the pre- and post-tests, 107 of these were girls and 144 were boys. The average pre-test score for the girls was 61.05, compared to a post-test score of 70.64, an increase of 9.59, and the average pre-test score for the boys was 60.95 compared to a post-test score of 72.81, a difference of 11.86. The girls scored .10 more than the boys on the pre-test and 2.17 less that the boys on the post-test.

These data, indicate that many students learn better from the computerized application of mathematics rather than theory. In one pilot school, this year's technical mathematics program has 12 students enrolled in tech math IV. Twenty-three students enrolled in a combined tech math IV and precalculus course in the other pilot school. Presently Fayette County has seven high schools participating in the tech math program including the two pilot schools. Because this program has been successful in Fayette County, several counties around the state have adopted tech math as a part of their mathematics programs.[4]

When looking specifically at computer use, a Johns-Hopkins University study found that 11th and 12th graders doubled their time on computers when compared with use by 5th graders. This study also found that the students who were in the top third of their class academically used computers more than those who were underachievers. The lower-achieving students who used computers, however, benefited in that computer use "improved motivation, self confidence and self discipline" and assisted them in developing better skills in language, reading and mathematics.[5]

II. ***Myths and Realities of Female vs Male Students in Mathematics Computer Technology and Science***

MYTH: ***Math is just too difficult for girls.***

REALITY: When comparing the scores on the "Comprehensive Tests of Basic Skills (Form U)" between the female and male students in West Virginia public schools for 1986, test scores showed that the mean score for 9th grade girls was 724.5 in computation and 696.3 in concepts and applications, while the boys' mean score was 732.0 in computation and 716.6 in concepts and applications. The computation score is only 7.5 points higher for boys than for girls, but is 20.3 higher for boys than for girls in concepts and applications. The mean score for 1985 for 11th grade girls was 743.3 in computation and 731.0 in concepts and applications while the boys' was 741.3 in computation and 732.3 in concepts and applications. The computation score was 2.0 points higher for girls than boys and the concepts and applications score was 1.3 points higher for boys than for girls in the 11th grade. However, there is no breakdown of the specific number of mathematics classes the female and male students have taken or are taking, which would tend to give a more accurate picture of why the boys' scores were higher at the 9th grade and girls' scores were higher at the 11th grade in computation.[6]

MYTH: ***Boys need more math courses than girls.***

REALITY: While traditionally it once was expected that boys would be "breadwinners," therefore, would need more math to get a well paying job and that girls would marry, have children and take care of the home and not need mathematics, John Lipkin and David Sadker concluded that the reality is: "The lack of preparation in math serves as a 'critical filter,' inhibiting or preventing girls from many science, math and technology related careers. Even for those students not going on to college, there is evidence that students who take high school geometry

and algebra receive substantially higher scores on employment entry tests for civil service, federal and private sector jobs than those who do not take math courses."[7]

MYTH: ***Boys far outnumber girls in computer use.***

REALITY: While males comprise 57 percent of the students (2,535) enrolled in Computer Math courses according to the "West Virginia Department of Education Course Enrollments in Public Secondary Schools Information" as of October, 1986, 75 percent of the students (1,082) enrolled in data processing and 81 percent of the students (663) enrolled in word processing were females (typically female oriented courses) and 46 percent of the students (302) enrolled in computer programming were males. Since there is a difference of only 8 percent more males than females taking computer programming, the fear is significant, but does not appear to be overwhelming in West Virginia.[8]

MYTH: ***Most girls do not fear computer courses because of the math courses they think are pre-requisites.***

REALITY: Males outnumbered females 2:1 in computer science and literacy in surveys completed in the States of Maryland, Michigan and California and "... researchers found that females have an exaggerated sense of the math required for success in these courses," which makes them less apt to seek a computer-related career.[9] In the West Virginia Tech Math Program in 1985-86, there were 14 percent more males than females enrolled who took both the pre- and post-tests.[10]

It is obvious that computer technology is an important factor in enabling students to deal with our ever-changing society. It is a quick way for students to learn math, to analyze test scores, to develop graphs on those test scores and to compare female and male test scores as well as a wealth of other uses (e.g., record keeping for schools and computing percentages).

MYTH: ***Boys are more oriented toward science than are girls.***

REALITY: Majorie W. Steinkamp and Martin L. Maehr studied gender differences in "Motivational Orientations Toward Achievement in School Science" and compared data related to both girls and boys. They found "Girls" motivational orientation was more positive than boys' in biological science and chemistry . . . whereas boys' surpassed girls in certain physical sciences . . . .. Males expressed more positive motivational orientations in testing environments containing a social component. . .." However, they indicated the differences in motivational orientation and achievement in science is relatively small.[11]

MYTH: ***Boys outperform girls in science in a middle school setting.***

REALITY: Marlaine E. Lockheed and others found modest sex differences in science performance between girls and boys in middle schools when the means were compared between these two groups. However, when a closer look was taken at the types of science performance and these were analyzed, it was found that boys performed only modestly better than the girls for application problems and in proportional recovering. There was very little difference between the girls and boys for propositional logic or combination tasks. Performance was basically the same for girls and boys as far as knowledge, comprehension and the higher processes were concerned. The method of teaching and whether students were familiar with the science equipment were noted as possible causes of differences between the groups' (girls and boys) means.[12]

These cited examples are just a few of the myths and realities of students taking courses in mathematics, computer technology and science. Students (of both genders) need to be treated equally and encouraged to remain in these courses s they will have more opportunities to get better paying jobs following graduation. Also, these courses will enable students to become astronomers, civil engineers, biochemists, physicists, doctors, forest rangers, economists or computer programmers.

III *Quiz Areas Educators Should Review to Help Students Remain in Mathematics, Computer Technology and Science Courses.*

Answer the questions provided in the quiz below. If the scores are too negative, determine what can be changed to provide more positive input for students in these three areas: mathematics, computer technology and science.

QUIZ

	YES	NO
1. Do courses in mathematics, computer technology and science, as well as other courses, show a fairly balanced enrollment of boys and girls?	____	____
2. Do course enrollments consist of 80 percent or more of students of one sex or another?	____	____
3. Were the students tracked into the courses?	____	____
4. Did students make the course selection themselves?	____	____
5. Are college, career and other materials displayed so that they are available to all students?	____	____
6. Does your career information reflect females and males in nontraditional roles?	____	____
7. Are the career choice materials that are provided to students, parents and teachers related to overcoming stereotyping and biases?	____	____
8. Have inservices been provided to deal with gender affirmative strategies for teachers to teach mathematics, computer technology, science and other courses?	____	____

	YES	NO
9. Have support groups been organized in your schools to deal with students who exhibit anxieties in taking advanced mathematics, computer programming, advanced science or other courses?	____	____
10. Are personal, academic and career counseling made available to all students in a nondiscriminatory manner?	____	____
11. Is testing for careers and courses free of sex bias?	____	____
12. Are students with disabilities and pregnant students offered the same career choices and services based upon their interests and abilities as are other students?	____	____
13. Has information been disseminated to teachers, counselors, administrators, other educators, students and parents, as well as others in the community, to publicize that your county does not discriminate on the basis of sex, race, color, national origin, religion, marital status, age and disability to its students and employees in its education programs and activities?	____	____

Adapted from:

Title IX Line Center for Sex Equity in Schools. (Vol. VI) Ann Arbor Michigan: The University of Michigan, School of Education, Winter, 1986.

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