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ABSTRACT

In the past, science textbooks have been the target of criticism of science educators in studies of sex bias in the past. The purpose of this study was to examine the illustrations in the biology textbooks most commonly used in high schools in the United States. Seven textbooks were examined for their representation of women in illustrations of scientific activity. It was expected that these textbooks would have women underrepresented as active participants in science activities, as compared with men. Illustrations that were identifiable by sex were coded based on the sex and activity shown in the illustration. It was found that, for the sample as a whole, females were just as likely to be shown as active participants in science activities as males. However, these books represent a trend toward favoring male participation in science; that is, some of the effects were masked by the sample as a whole. Individual textbook differences were examined and a range of representatives was found. (Attached are a bibliography of 30 items and a list of the texts used in the study.) (Author)

Evidence for the Lack of Sexism in Biology Textbooks: A Mistaken Impression

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Abstract

Science textbooks have been the target of criticism of science educators in studies of sex bias in the past. The purpose of this study was to examine the illustrations in the biology textbooks most commonly used in high schools in the United States. Seven textbooks were examined for their representation of women in illustrations of scientific activity. It was expected that these textbooks would have women underrepresented as active participants in science activities, as compared with men. Illustrations that were identifiable by sex were coded based on the sex and activity shown in the illustration. It was found that, for the sample as a whole, females were just as likely to be shown as active participants in science activities as males. However, these books represent a trend toward favoring male participation in science; that is, some of the effects were masked in the sample as a whole. Individual textbook differences were examined and a range of representations was found.

Introduction

The factors which contribute to the socialization of women have been of concern for some time. Berger (1977) states that through this socialization women are being prepared for an inappropriate and dysfunctional role in society. A majority of women are required to find employment to support themselves and their families (Corcoran, Duncan and Ponza, 1984), yet they are socialized to be ineffective in careers, especially those in science and technology fields which provide the best pay and highest prestige. The disparity between what women are socialized to do and what is economically demanded of them is evidenced by the fact that a majority of women are concentrated in fields of employment with low wages and few promotional opportunities compared with men (Fox and Hesse-Biber, 1984). The overrepresentation of women in these areas of employment is detrimental for several reasons. Such women are denied access to prestige and much needed economic rewards. This also means that a great deal of human capacity, needed in ever growing science and technology fields is going unrealized.

A 1988 National Science Foundation report, *Women and Minorities in Science and Engineering*, indicated serious inequities in the representation of women in science and engineering. Although women constituted 44% of the labor force in 1986, they held only 15% of all engineering and science related positions. Specifically, 88.6% of the physical science, life science, computer science, environmental science, mathematics, and engineering jobs involving teaching, production, inspection, reporting, analyzing or computing and requiring at least a bachelors degree are held by men. Though males make up only 49% of the population of the United States, they dominate employment in science and engineering fields (Malcom 1984). This can not be completely accounted for by

hiring practices among employers. Part of the problem lies in the numbers of women in the pool of potential scientists from which employers draw. Though women represent 52% of all students taking the Scholastic Aptitude Test (SAT) and academic enrollment of boys and girls in U.S. high schools is essentially equal, 48% of boys intend to pursue a career in science and engineering and only 28% of the girls report such intentions (Malcom, 1984).

Some researchers have indicated that the educational system itself contributes to this situation (Walford, 1983; Bertilson et. al, 1982). Through their educational careers, students are bombarded with the message, also pervasive in other areas of society, that occupational aspirations and opportunities as well as lifestyles are determined by gender. These expectations and beliefs effect the educational and career goals of young women, causing them to avoid areas of high competition and prestige such as science and technical fields (Britton, 1973). Kelly (1985) states that there are four ways that science can be made to appear masculine. One of these areas is packaging; that is, the way science is presented in classroom materials including the images in textbooks.

The images of men and women in textbooks are very influential (Walford, 1980; Cohen and Cohen, 1980) They can support traditional sex role stereotypes or, by representing women as active participants in science they can encourage female students to participate equally with their male peers. Studies from the 1970's and 80's have indicated that physics (Walford 1980, 1981, 1983; Kelly 1975; and Taylor 1979) and chemistry (Heikkinen, 1978) textbooks support the stereotype of the physical sciences as exclusively masculine in nature. Heikkinen's study found that chemistry textbooks from the 1940's through the revisions of the 1970's were all dominated by male images. The same masculine bias has been shown for mathematics textbooks (Christoplos and Borden, 1978; Kepner and Koehn, 1977; Kuhnke, 1977). Though biology textbooks have been mentioned less frequently, Kahle (1987) noted the underrepresentation of women

in illustrations in biology texts of the early 1980's.

Many publishers have issued guidelines for the elimination of one-sided or sexist portrayals of men and women in their materials (Britton and Lumpkin, 1976; Weston and Stein, 1978), yet some researchers feel that the newer texts lack significant improvement (Bertilson et al, 1982). The purpose of this study was to examine the illustrations in the most widely used high school biology textbooks. The illustrations were examined for sex and type of participation of the subjects. The expectation was that the textbooks would significantly underrepresent active females, as compared to active males, in illustrations of scientific activity.

Method

Materials Examined

This research examined the illustrations in seven commonly used high school biology textbooks (Mahamoud, 1981; Weiss, 1987). (See Appendix A) The texts were published between 1983 and 1986.

Procedure

The illustrations in each textbook were examined to determine which were of people engaged in scientific activity. Illustrations were included only if the subject could be clearly identified by sex. Illustrations of hands and figures with ambiguous characteristics were excluded. For example, a photograph of an astronaut floating in space was omitted from the analysis because, although it could easily be presumed male, it was not clearly identifiable by sex. Detailed drawings where the individual was clearly identifiable by sex were included. However, outlines of persons were not.

Each illustration was analyzed based on the overall impression it conveyed under the assumption that the collection of figures in an illustration creates an intact hegemonic unit. Therefore, collages, illustrations with

multiple figures and sets of overlapping illustrations were treated as single illustrations to be examined. It is important to note that the captions which accompanied the illustrations were ignored. The setting of an illustration, such as in special career or historical features, was likewise ignored. This approach was used based on the belief that illustrations convey immediate messages that are independent of the accompanying text.

Each illustration in the study was examined on the basis of sex and activity. One of four possible codes was assigned in each case: female active, female passive, male active, male passive. In illustrations with only one identifiable person, the sex of that individual was coded as either female or male. Illustrations with multiple figures in which there was no difference in activity level among the participants were given one code based on the sex category of the numerical majority in the illustration. When a difference in activity level was present, illustrations with multiple images were given one code based on the sex category of the active participant. In cases where activity level was equivalent and males and females were equally represented, the position of the participants relative to each other was considered. For example, when one male and one female were present and equally active, the sex shown in the foreground or in a physically superior position determined the code given to that illustration. The same guidelines were used in cases where multiple females and multiple males were present in equal numbers and equally active.

Scientific activity, the other characteristic under study, was defined as anything involving the use of scientific equipment, measuring effects, or recording data. An illustration could be coded as active (scientific activity) or passive (nonscientific activity). Images in the career and historical features were analyzed based on the same criterion as other illustrations; they were not assumed to be active. The subjects of experiments or medical treatments in illustrations of scientific activity were considered passive.

When all relevant illustrations in each textbook were coded and counted, eleven chi-square tests were performed to determine significant differences between and within textbooks

Results

The percentage of codable illustrations was relatively low, ranging from 11 to 28 per cent. On the average, less than one-fifth of the illustrations in each biology textbook contained recognizable human images. Though biology has been considered more attractive to girls due to the inclusion of social and human factors (Kahle, 1988; Kelly, 1987) , the low percentages of human images in this study indicates that the illustrations in biology textbooks do no support this assertion.

Other studies have shown textbooks to be sex-biased based on the percentage of females and males shown in the illustrations (Heikkinen, 1978; Walford, 1981; Kahle, 1987). However, the present study found that numerical representation of males and females was inconclusive with regard to sex bias in the textbooks. The range of percentages was wide, varying from 59:41 favoring females to 62:38 favoring males. Regarding the sample as a whole, no significant differences were found comparing the percentages of males to females, the percentages of active males to active females, or the percentages of passive males to passive females. However, all of these comparisons indicated a trend toward favoring the percentage of males in each category. Drawing inferences from numerical representation alone can be misleading because it does not take into account the activity level of the individuals. Thus. although a higher percentage of women may be found in textbook illustrations they may still be portrayed as passive observers or ineffective practitioners of science. As a result, such texts convey the same traditional sex-role messages to students as textbooks with very low percentages of women

in illustrations. In either case, the message is that women do not belong in the sciences.It should be noted at this point that these same differences could achieve significance in a larger sample.

Significant differences were detected in the number of relevant illustrations between textbooks, the percentage of women represented between textbooks, the percentage of men represented between textbooks, the percentage of active women represented between textbooks, the percentage of active men represented between textbooks, and the percentage of passive females represented between textbooks. The differences between textbooks approached significance regarding the percentage of passive males represented and the percentage of relevant illustrations compared to the total number of illustrations in a textbook. Regarding individual textbooks, one text (BSCS Blue) had a significantly higher percentage of females than males; two (Scott-Foresman and Holt) were significant favoring a male representation. One textbook (BSCS Blue) had a significantly higher percentage of active females than males; one (Holt) had a significantly higher percentage of active males than active females. Two textbooks (Heath and Scott-Foresman) had a significantly higher percentage of passive males present than passive females (See Appendix B).

Discussion

Students are often confronted with their own invisibility in the language and illustrations of textbooks. The mandatory nature of education in the United States assures that young women using sexist textbooks will, unless some intervention is made, eventually memorize the message that they are irrelevant in important areas of life (Britton, 1973; Walford, 1983). The results of this study have shown that the illustrations in the most commonly used high school biology textbooks were varied in the degree to which they depict women as

active participants in science. On the surface, it may appear that the publishers of biology textbooks as a group have taken seriously the problem of the underrepresentation of women in science and the role of textbooks in this situation. However, there is a great deal of variation between biology textbooks. Teachers and administrators should be made aware of these differences in order to make informed decisions about which textbook is most appropriate for the students in their biology classes. If this were indeed the case, a factor (the representation of women in textbooks) that has traditionally served to discourage women from participation in science careers may serve to encourage them. Such increased sensitivity to the issue of the role of subtle messages in text materials may contribute to an increase in the number of women in the pool of future scientists and to increased utilization of human potential.

Although the results of this study indicate that young women may see images of women being active in science and thus be encouraged to participate themselves, there remains the possibility of subtle discouragement in textbooks. For example, women may be shown in scientific roles which are drastically incongruent with the messages of other social forces and thus may seem unattainable. Such illustrations may discourage rather than encourage participation with the message that successful participation is not compatible with traditional aspects of a woman's life and would require superhuman capabilities or extraordinary sacrifice (Scott and Feldman-Summers, 1979). Thus, illustrations which show extraordinary women scientists such as Nobel Prize winners are less likely to be encouraging than illustrations of women physicians and researchers.

Representation of women and men in science activity in textbooks is an important aspect of sex equity in biology education. However, inequality between women and men in illustrations of science activity can be conveyed in other ways. The physical position of men and women indicating the traditional

relationships of dominance and subordinance between the sexes also varies between textbooks. If men are more likely than women to be shown in a dominant physical position relative to the opposite sex, inequality between the sexes is present. Another factor which could discourage women from participation in science careers is the adherence to traditional gender roles among the science careers represented in a textbook. This aspect of the representation of the sexes varies as well (Warren, 1988).

Once identified, these factors of sex bias in science textbooks could be used to create a tool to measure the level of bias. This tool would be valuable to publishers, teachers, administrators, and researchers in formative and summative textbook evaluation, and in the measurement of the effect of such materials on the science attitudes and career choices of the girls and boys in our schools.

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Appendix A

Bibliography of the Sample

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Appendix B

Descriptive Statics of Biology Textbook Illustrations

Source	Total Relevant Illustrations	% of Total Illus.	% Overall Illus. Female	% Overall Illus. Male	% Active Illus. Female	% Active Illus. Male	% Passive Illus. Female	% Passive Illus. Male
BSCS Blue	51	21	59	41	63	37	52	48
BSCS Green	86	28	50	50	54	46	45	55
Silver Burdett	45	17	49	51	52	48	44	56
DC Heath	53	15	43	57	52	48	37	63
Merrill	80	19	45	55	43	57	47	53
Scott-Foresman	88	21	38	62	43	57	27	73
Holt	37	11	41	59	33	67	54	46
Total Sample	440	17	46	54	49	51	43	57
χ^2	42.75*	9.17	6.28	5.45	11.65**	11.00**	11.70**	9.09

* $p < .01$
** $p < .10$