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ABSTRACT

In the past, science textbooks have been the target of criticism by educators and feminists in studies of sex bias in education. The purpose of this study was to develop a useful tool that could be used in formative or summative evaluation of the level of sexism in science textbooks and as a research tool to study the effect of sexist instructional materials on the course choices made by secondary school students. Seven popular grade 10 biology textbooks were examined for their representation of women in illustrations of scientific activity. Three variables were examined in each of the biology textbooks; gender represented by the image; the presence/absence of dominance between persons in an illustration; and the traditional/nontraditional nature of the activity of the individuals in the illustration. It was expected that these factors would help to explain the variation in the impression left with a person by these texts. Using multiple linear regression methods, it was found that these three factors accounted for a significant portion of the variance among the textbooks. Another factor, intensity, the number of illustrations which carry these socializing messages in a given text, has emerged from the study of this data. (Lists of 39 references and the 7 textbooks are provided.) (Author)

The Use of Ordinary Least-Squares Regression in the Development of an Instrument to Measure Sexism in Biology Textbooks

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Abstract

Science textbooks have been the target of criticism by educators and feminists in studies of sex bias in education in the past. The purpose of this study was to develop a useful tool that could be used in formative or summative evaluation of the level of sexism in science textbooks and as a research tool to study the effect of sexist instructional materials on the course choices made by secondary school students. Seven popular grade 10 biology textbooks were examined for their representation of women in illustrations of scientific activity. Three variables were examined in each of the biology textbooks; gender represented by the image, the presence/absence of dominance between persons in an illustration, and the traditional/nontraditional nature of the activity of the individuals in the illustration. It was expected that these factors would help to explain the variation in the impression left with a person by these texts. Using multiple linear regression methods, it was found that these three factors accounted for a significant portion of the variance among the textbooks. Another factor, intensity, the number of illustrations which carry these socializing messages in a given text, has emerged from the study of this data.

Introduction

The factors which contribute to the socialization of women have been of concern to researchers 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 Fonza, 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 betwe - 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 ompletely 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 and, using the relationship of sex, dominance, and tradition in those illustrations, develop a tool to measure the overall impression (sexist- nonsexist) left by the texts.

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

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, dominance

and tradition. 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. Categories for sex were female, neutral, male (high to low).

The position of the participants relative to each other was considered to determine the presence, absence (high, low) of dominance. Dominance could be demonstrated by a numerical majority, position of one person to another (above or below; foreground or background). Single persons in an image could not, by definition, represent the presence of dominance.

The third factor, tradition was coded nontraditional, no established tradition, traditional (high to low). This determination was made based on the nature of the activity the person in the image was engaged in. The determination of whether an activity was traditional or nontraditional was based on the traditional societal division of labor placing females in nurturant or domestic roles such as nurse or cook, and males in objective roles such as scientist or machinist (Martin, 1985).

A chi-square analysis was done on each of the factors to determine simple significant differences between texts at each level of the factors. These data helped to assign relative rank to each of the texts based on the overall impression obtained from the book. A standardized scale was produced by using the range for each factor as independent variables. The standardized ranges were scaled positively and weighted according to the emphasis given to pictures of people each text. Multiple regression were performed on these standardized scaled scores both weighted and unweighted.

Results

The number of codable illustrations ranged significantly, $\chi^2(6, N=7) = 54.9$, $p<.001$. 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 not support this assertion. Because of the wide range of numbers of illustrations, the textbooks were grouped and given a multiplier to account for this based on groups of 20 illustrations. For example, since Scott-Foresman *Biology* contained 104 illustrations that included human figures, a multiplier of six was applied as a weight to account for the added emphasis of more illustrations.

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). 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, varing from 58:35 favoring females to 54:32 favoring males. There was a significant difference between textbooks regarding the percentage of women, $\chi^2(6,N=7) = 12.13$, $p=.06$, but no significant difference in the percentages of males shown. Overall, the difference between the percentages of females and males was significantly insignificant, but it still favored males (45:40).

There was statistical significance also shown between texbocks in terms of the percentages of dominance shown, $\chi^2(6,N=7) = 11.29$, $p=.10$; persons in traditional occupations, $\chi^2(6,N=7) = 11.60$, $p=.10$; persons active in occupations where there is no established tradition, $\chi^2(6,N=7) = 13.16$, $p=.05$;

and person represented in nontraditional occupations, $\chi^2(6,N=7) = 13.32.p=.05.$

When the scaled, weighted data were intercorrelated, two significant interactions were detected. Dominance was positively correlated with sex (r=.779) and text rank was negatively correlated with tradition (r=-.772). Univariate F tests found that when textbooks were weighted, all three factors were significant between textbooks; sex, F=.02, dominance, F=.006, and tradition, F=.002.

The results of the multiple regression analysis showed that the tradition factor was responsible for nearly 60% of the variance between textbooks, $R^2=.596$. When dominance and sex were added, the combination was responsible for 74% of the variance between the textbooks, $R^2=.743$.

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 eventually memorize the message that they are irrelevant in important areas of life unless some intervention is made (Britton, 1973; Walford, 1983). There is a great deal of variability between textbooks in regard to factors which influence the gender roles of children. The results of this study have shown that a substantial amount of the variance can be accounted for by the factors of sex, tradition, and dominance. The effect of intensity, actually the frequency with which messages are given by a source textbook, also accounts for some of the variability between textbooks. The measures relationship of these factors did allow a reasonable prediction of the relative rank of each textbook within the sample. Other factors have also been identified and will need to be tested to further refine the model (Warren and Rogers, 1988).

With regards to the effect of these materials on the course and career choices made by students, the amount of such an effect is not known. By creating a tool for assessing the subliminal sex bias in school textbooks, it is hoped that school administrators and teachers will have a means of sensitively choosing the textbooks for use with their classes, publishers will be able to formulate plans for preventing sex bias in the formative stages of textbook publication, and researchers will have a tool to test the effect of different forms of subliminal bias on school aged children. Before this instrument can be ready for general use, however, it must be tested on several different samples of textbooks from different science disciplines at different grade levels to establish its reliability.

Even though several publishing companies have guidelines for preventing this kind of bias in textbooks (Britton and Lumpkin, 197[illegible], 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 illustratons of women physicians and researchers. The representation of women and men in science activity is an important aspect of sex equity in biology textbooks.

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Appendix A

Bibliography of the Sample

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Descriptive Statistics by Textbook

TEXT	Text Rank	N	% of Total	Percent Female	Percent Neutral	Percent Male	Percent Dom	%Not Dom	Percent Trad	%Not Estab.	%Not Trad.
BSCS Blue	1	48	22.1	58	6	35	27	73	40	29	31
BSCS Green	2	94	28.1	42	17	41	42	58	46	25	29
Merrill	3	92	19.4	39	17	44	24	76	39	37	24
Scott-Foresman	4	104	23.1	31	14	55	19	81	48	35	17
Silver-Burdett	5	55	17.0	42	15	44	29	71	33	40	27
DC Heath	6	60	15.2	37	18	45	33	67	38	50	12
Holt	7	41	11.8	32	15	54	34	66	61	27	12
Total Sample		493									
Means		70.6	19.5	40.14	14.57	45.43	29.71	70.29	43.57	34.71	21.71
St. Deviation		25.37	5.44	9.01	4.04	7.04	7.47	7.48	9.18	8.69	7.99
χ^2		54.90*	9.11	12.13@	6.14	6.56	11.29#	4.77	11.60#	13.16*	13.32*

* $p < .05$
@ $p < .06$
# $p < .10$

Factors Effecting Choice of Science Careers

Locus of Control
SES
Parent Attitudes
Parent Education
Peers
Teacher Attitudes
Other School Factors
Television
Other Media

Instructional Media
- Films
- TEXTs
- Others

Learned and Reinforced Gender Roles [Constraints]

Choices
- Courses
- Career

Remain in Science Pipeline

Drop out of Science Pipeline