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ABSTRACT

Gender bias in education remains widespread and has multiple forms. The purpose of this study was to examine current popular mathematics computer programs (n=12) intended for grades K-6 with attention to the symbolic representations and graphics used in the instructional part of the program. The review form tallied the number of main characters, their gender, their role (active versus passive), and the type of item(s) they used. The roles were noted as either traditional or nontraditional. Results showed that 41.7 percent of the software programs had main characters that were gender identifiable. Of these programs, only 12.5 percent of the main characters were female. The female main characters in the software all represented traditional female roles. A table included at the end of the report contains the software studied, appropriate grade level, summary of program, characters, and roles. Contains 17 references. (Author/MKR)

Gender Representations in Mathematics Software

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Abstract

A review of current elementary mathematics software found that 41.7 percent of the software programs had main characters that were gender identifiable. Of these programs, only 12.5 percent of the main characters were female. Such bias can effect the attitudes and achievement of female students. The female main characters in the software all represented traditional female roles. There is a need for further research on the effects of the absence of females in software and the exclusive use of traditional roles for characters.

Key words: software design

gender roles

mathematics education

visual illustrations

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Introduction

Gender bias in education remains widespread and has multiple forms. Bias has been documented in classroom interactions where males and females are treated differentially (Sadker & Sadker, 1982; AAUW, 1992). Texts and the curriculum are frequently biased, and either ignore the contribution of women or portray them as abnormal (Mendelsohn et al., 1994; AAUW, 1992). Reports of bias in tests and scoring are frequent (Wiersma & Jurs, 1990). Women have made few gains in athletics (Blum, 1994).

Early research on computer software design supports the negative impact of biased instruction on learning. In a text-only computer tutorial, females who received noncorrective feedback (verbal messages) scored significantly lower on a posttest than did males receiving noncorrective feedback (Hodes, 1985).

Computer use is male-dominated above the middle school grades with elective courses in computer programming being predominately male (Becker, 1987). At the high school level, female computer use is often limited to word processing and business courses. A recent study notes the differences between school-aged males and females when playing various computer games (Edwards, 1994). Female students more strongly identified with the main characters in the software and tended to be more interested in relationships among the characters. Females are also more likely to assign gender to gender-neutral characters, such as trolls. Females were more likely to display lower confidence than males for using a computer, and they were less likely to try to join a male at a computer to collaborate.

As computers have become more commonplace for instructional use in the classroom, advances in software include more graphics and animation. Instruction enhanced with graphics presents concepts in a social context that portrays the dominate culture and social structure. Thus, the lesson today's students receive is much more than the verbal message. The message includes information about cultural categories such as gender roles.

In the area of mathematics, the National Council of Teachers of Mathematics (NCTM) outlined five goals for all students. Two of the five goals state that students should learn to value mathematics and become confident about their math ability (NCTM, 1989). Well-designed computer programs should be able to help students achieve these by presenting math instruction in a relevant context and providing real-world applications, both of which can build intrinsic motivation.

The purpose of the present study is to examine current popular math software intended for grades K-6. The software is examined with attention to the symbolic representations and graphics used in the instructional part of the program. Graphics are considered as important as the content of the lesson since graphics supplement the lesson's information and supply information about the culture and context of the lesson content. The software programs and their graphics are categorized with regard to main character, gender frequency, and gender roles to determine the trends and status of educational mathematics software design.

Similar studies have been done with print materials. Crabbe and Bielawski (1994) reviewed more than five decades of children's literature to examine the illustrations and determine the patterns of representation of gender and material culture. In particular, items are important since they reflect the material culture and have been constructed intentionally, representing social roles and classification systems. Such socially oriented representations can influence students when used in educational materials. In their examination of children's literature, Crabbe and Bielawski found that a larger proportion of females used domestic items while a larger proportion of males used items representing technology or nondomestic items.

Mendelsohn et al. (1994) conducted a similar study with medical textbooks. Concentrating exclusively on the medical illustrations, they tabulated the frequency of use of the male versus the female physique in both anatomy and diagnostic textbooks most commonly used in U. S. medical schools. These texts treated the male anatomy as the norm with men constituting from 77 to 90 percent of the gender-identifiable, non-reproductive illustrations. These and other aspects of the illustrations reinforce the traditional protective attitude toward women and that their primary societal role is reproductive.

Method

Popular mathematics software released within the past five years was reviewed using a combination of the methods of Crabbe and Bielawski (1994) and Mendelsohn et al. (1994). Both studies examined and categorized illustrations with regard to gender representations.

The study of Crabbe and Bielawski classified items appearing in the illustrations. They used the following classifications: household (domestic items), production (for work outside the home), and personal (for grooming or leisure). The proportions of each type of item was tabulated along with the gender of the character using the item.

The study of Mendelsohn et al. tabulated the frequency of appearance of males and females in various classes of text, either anatomy texts or diagnostic texts, and further classified the illustrations as reproductive and nonreproductive. The study was limited to the five most popular texts in each category.

The present study examined twelve mathematics computer programs designed for elementary (K-6) students. These programs were all designed for instructional use and were not exclusively games. The review form tallied the number of main characters, their gender, their role (active versus passive), and the type of item(s) they used. The roles were noted as either traditional or nontraditional.

Definitions of the nontraditional roles for females were those used by the Pennsylvania Department of Labor and Industry. For example, a nontraditional role for a female would be a construction worker, mechanic, truck driver, or engineer, while a traditional role for a female, is a teacher, nurse, or clerical.

Results

Two primary structures were found in the current software programs with regard to gender representation. Most of the programs (58.3 percent) had no main character that was gender identifiable (Table I.). Two subcategories of this type were programs that used either animal characters or genderless space aliens, for example; the second subcategory of genderless program avoided using any type of human or animal in the graphics, relying on pictures of clocks with human-like faces in the introductory frame or presenting no graphic illustration at all.

< Table I >

The second type of software design used gender-identifiable characters throughout the program, either animals, such as a bear family, or humans. Of the remaining 41.7 percent of the programs, all had main characters that were gender identifiable. Only two of these programs included female characters, and those were a mother and a princess.

Roles of the male characters found in mathematics software included heavy equipment operators, factory workers, shop keepers, mountain climbers, hang gliders, garage mechanics, and one program used a male genie as an authority figure to give directions. The males were all represented in traditional roles.

The appearance of males outnumbered the appearance of females in the programs, with males totaling 87.5 percent of the main characters in these programs. Tabulation of the type of items used by the main characters was abandoned since the roles of each character was traditional and the appearance of the females was so sparse. Also, the princess did not touch any but personal items (i.e., her crown) and the personal items were treated as a neutral category by Crabbe and Bielawski.

Discussion

The mathematics programs reviewed here show two main design patterns. Although this is a somewhat limited sample, it is representative of the popular software. The trend for mathematics software is either genderless or gender-identifiable, sparse use of female characters, and characters of both genders limited to traditional roles. Images in software are important since they provide a context in which instruction is anchored and give unstated information about the culture.

Limiting graphic presentations to traditional roles is of special concern, especially if the user is a younger student. Bigler and Liben (1992) remind us that young children have limited classification skills and that their beliefs about gender stereotypes are very rigid. The classifications presented to young children impact their formation of concepts and, therefore, their understanding of who can fill various occupational roles.

Mathematics has long been an area of concern with regard to young women since so many women enter secondary school deficient in math skill and with negative attitudes (AAUW, 1992; Hodes, 1985). A major report issued by the American Association of University Women (1992), "How Schools Shortchange Girls," notes that curricula still marginalize and ignore the experiences of females, delivering an incomplete message by failing to reflect the diversity in their lives. Images presented in instructional materials can either strengthen or decrease motivation by having images consistent with the students' culture and identity.

Crabbe and Bielawski (1994) express concern that exposure to gender stereotypes may summate over a lifetime to explain some of the differences commonly found in both the educational and career paths between males and females. Attitudes form during the K-8 years, and students attitudes toward subjects like math influence their educational choices (Goodwin, 1985).

Much of our language, research and cultural norms are stated in terms that all but deny the existence of women (Matlin, 1993). Many theories in psychology and medicine are based exclusively on studies of male subjects. Unfortunately, exposure to gender stereotypes occurs frequently in the classroom.

Sadker and Sadker (1985) and Conroy (1988) document that classroom interactions almost always favor the male students. Should it surprise us when educational software follows?

Mendelsohn et al. (1994) summarize the traditional view of females in our society as part of the explanation for excluding them not only from instruction, but from many major medical studies as well. Women appear less frequently in texts since they have less societal worth. Women are still seen as childbearers and subordinates. They feel that overcoming the bias, especially in the area of medical education, can help improve women's health care.

With hope, the instructional software designers will also develop an awareness of gender bias and its effect. Math is often viewed as a male area and females are more likely to suffer math anxiety due to such negative associations (Sgroi & Sgroi, 1993). Balancing instructional software to encourage female students is not a difficult task. Gender-balanced instruction, as well as the presentation of both males and females in nontraditional roles, can bring about educational equity and increase learning motivation (Scott & Schau, 1985). Mathematics software should be compared to the NCTM goals and curriculum standards (1989). Where the NCTM hopes to see all students with increased confidence in math and a better understanding of its value, male-oriented software may serve to undermine not only these goals but also the efforts of the teachers.

Conclusions

Gender bias is a serious problem in our society and has been well documented in our schools. The present study presents a framework for further study of current software design. Further research is needed to determine the effect of these software types on attitudes and achievement.

Although a majority of the software in this review did not use gender in the program, the programs using gender-identifiable figures were male-oriented. This is not a recommendation for genderless software. Linking mathematics instruction to real-life applications can best be done by using actual situations. Graphics are part of a rich context with which we can present instruction. Teachers who acquire software should review the program's content and context for gender bias prior to purchase.

Current software must represent the diversity within our culture and include women in realistic roles. When accurate representation of females is absent from contemporary software, we should become concerned about the effect this will have on the students. Their math achievement is only one area of concern. We must realize that elementary students have developing self images and are forming concepts about gender roles.

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Table I.

Main Characters and Their Roles

Program	Level	Summary	Characters	Roles
Kids Math	N-3	8 Activities on menu: counting, sequences, etc.	2 males in only one activity	both heavy equipment operators
Coin Critters	N-3	Activities with coins	none	none
Clock Shop	N-3	Time problems	none	none
Sticky Bear Math	k-4	Math in context of neighborhood with a store, factory, shops, office, etc. Travel with a Bear family of 3. All characters are animals.	Various male workers such as clerks. The mother bear is a female, father a male, baby is genderless.	garage mechanics, factory workers, policeman, store keeper (all male)
Math Rabbit	K-4	Counting and math activities	animals	circus performers
New Math Blaster	3-6	Math facts with a space theme	genderless space people	Appear throughout to add interest
Bounce!	K-6	Math Patterns	Male genie	Gives directions
Turbo Math Facts	3-6	Math Facts, race car theme	none (uses cars)	none
Treasure Math Storm	3-6	Solve problems while climbing mountain to find treasure	Montain climber, shopkeeper, princess	Mt. Climber is principal (all male except princess)
Safari Search	3-6	Problems with animals & plants	none	none
Number Maze	3-6	Solve problems to move through maze	object-move with mouse	none
Flying Through Math	4-6	Solve problems with hang glider	3 male hang glider pilots	pilots of hang gliders