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ABSTRACT

Although many view computers purely as technological tools to be utilized in the classroom and workplace, attention has been drawn to the social differences computers perpetuate, including those of race, class, and gender. This paper focuses on gender and computing by examining recent analyses in regards to content, form, and usage concerns. The content of educational software packages has been critically examined to reveal partiality in their design; this encompasses differences in software design, concern for race, socioeconomic class, and gender stereotypes in the overall text, and the lack of quality evaluation of educational software to identify gender bias. Other research is rooted in theory that microcomputers have been developed through mathematics and science, typically viewed as masculine fields; an inherent bias toward male-dominated thinking results. The question of who is using computers and how they are being used has raised the issue of access. In order to ensure equity in microcomputer use, all students must have equal opportunity to learn about and use computers. While it may be apparent how differences in socioeconomic class would allow for these discrepancies in access, issues of gender become noticeable upon examination when coupled with the fact that most computers were initially associated with mathematics and science departments. This has affected the way computing is taught, the location of computers, integration of computers into schools, and use of computers in schools. (Contains 20 references.) (AEF)

# Title:

# Understanding the Critics of Educational Technology: Gender Inequities and Computers 1983-1993

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Although many view computers purely as technological tools to be utilized in the classroom and workplace, attention has been drawn to the social differences computers perpetuate, including those of race, class, and gender. (Campbell, 1984; Damarin, 1989; Huff et al., 1987) These differences are the result of a combination of many factors. Arguments have ranged from the view of computing as a culture to the content of the software that the computers utilize. This paper focuses on gender and computing by examining recent analyses in regards to content, form, and usage concerns.

The content of educational software packages has been critically examined to reveal partiality in their design (Huff and Cooper, 1987; Biraimah, 1989; DeVaney, 1993; Rosenthal et al., 1988; Benoit et al., 1991). This class of critiques encompasses differences in software design, concern for race, socioeconomic class, and gender stereotypes in the overall text of the software, and the lack of quality evaluation of educational software to identify gender bias.

Other research has focused on the machine in it's most basic form, and have shown that it has the same effects (Turkle, 1984; Damarin, 1993; Bush, 1983). These studies are rooted in the theory that microcomputers have been developed through mathematics and science, typically viewed as masculine fields. Therefore, there is an inherent bias toward male-dominated thinking. As a result, the way the user approaches the computer can have an effect on his/her success or failure.

Finally, the question of who is using computers and how they are being used has raised the issue of access (Campbell, 1984; Hawkins, 1987; Lockheed, 1985; Nelson et al., 1990). In order to ensure equity in microcomputer use, all students must have equal opportunity to learn about and use computers. While it may be apparent how differences in socioeconomic class would allow for these discrepancies in access, issues of gender become apparent upon examination when coupled with the fact that most computers were initially associated with mathematics and science departments. This has effected the way computing is taught, the location of the computers, the integration of computers into schools, and the uses of computers in the schools.

Content

Concerns regarding educational software content have been of interest since the incorporation of microcomputers into classrooms. While some practicing teachers may find it feasible to design software for their classrooms using a variety of programming languages and authoring systems, the reality is that most teachers have to use preexisting software packages. As a result, there is concern for the quality of this software, as well as the lack of appropriate means for evaluating and detecting gender bias. A sampling of the critics of software design methods will be examined first.

Huff and Cooper (1987) conducted a study regarding software and it's design. The purpose was to specifically test for gender differences in software designed by experienced educators. This exercise led to interesting results. Regardless of the gender of the software designer, there were differences in the programs designed for male, female, and a mixed class of male and female students.

The software designed for males was more game-oriented and action-based. The software which was designed for female students was more tool-oriented, reflecting their recognition of the computer as a learning tool. While this is consistent with other research of this nature (Turkle, 1984), what is truly shocking is that the software that was designed for the heterogeneous group was most similar to that designed for male students, i.e. game-oriented. What this indicates is that there is a perceived difference between the types of software that male and female students prefer by teachers designing software.

It is interesting to note that those involved in Huff and Cooper's experimental design were experienced classroom teachers. These are individuals expected to be concerned with the format of educational software in regards to interest groups and should therefore be most conscientious in their design.

The actuality of educational software design is that although the audience may be mixed, the programs are designed with male characteristics. There have been numerous studies which coincide with these findings (Kiesler et al., 1985, Hawkins, 1987). If the software being used in the classroom is designed with a particular sex in mind, and it is the "wrong sex" for the user, then anxiety level could rise and learning decline.

What Huff and Cooper have suggested as a possible solution is that software be designed that has game and tool characteristics so that it will be appealing to both sexes. This solution is a valid one, but it does not take into account the preexisting software which is being used in classrooms.

Karen Biraimah (1989) addresses the issue of content in prepackaged educational software in her article "Inequalities in Classroom Computer Software." She suggested that software, like texts, transmit knowledge, including values which are those of the designer. The problem with this model is that the software designer is usually a member of the societal majority. Due to this membership, students are exposed to stereotypes and values, with disregard for those who do not hold those Anglo-middle class male views. As a result of her acceptance of this concept, the author surveyed fifteen educational software packages. Her findings were congruent with related studies. (Benoit et al., 1991; Campbell, 1984; DeVaney, 1993; Rosenthal et al., 1991) The gender and ethnic under-representation which had been previously found in textbooks, held true in the software. Biraimah stated her results as follows: "software, like other instructional materials, is directed towards a male audience, with little sensitivity for the multicultural aspects of American classrooms." (1989, p. 5)

By comparing bias found in textbooks to educational software, the author was able to identify disparities in educational software which are currently in use. Ann DeVaney (1993) went deeper into the issue by examining an individual piece of software currently regarded as one of the best educational programs on the market.

In her article entitled "Reading Educational Computer Programs", DeVaney examined the content of computer software by viewing the program as a text that has been constructed in, and should be examined through, a social context (1993). By utilizing reception theory, she analyzed messages contained in the text. DeVaney felt that this text is the product of a larger discourse, one which belongs to the software author(s). Since the software entices students into this larger discourse, it is important to examine it's contents.

DeVaney analyzes the popular software "Where in the World is Carmen San Diego?" and the social discourse of which it is a part. Her findings indicate that this text is not neutral. On the contrary, she found indications of a program which reflects sexist, white, American values. She theorized this to the existence of two readers of the program: the computer and the user. Because the user is forced to read the program designed to be read by the computer, the user becomes constructed as a machine. The solution to this problem, as proposed by the author, lies in the finding of an alternative to this type of construction within the limitations of the hardware.

While this demonstrates the need to effectively and critically evaluate software that is to be used in the classroom, there is a lack of methodology in this regard among classroom practitioners. This is not to claim that software is not being evaluated, but may not be evaluated in all necessary dimensions. The bias contained in software is now more subtle then in the beginnings of software development, yet it can have the same detrimental effects. Therefore, there is a demand for more effective evaluation of software in regards to gender differences.

This issue was raised by Rosenthal and Demetrulias (1988) in their study of pre-service and practicing teachers and the effect of different evaluation forms on their identification of software as containing bias or stereotypes. The authors proposed that the more attention the evaluation form paid to gender bias, the evaluator would respond likewise and also pay more attention to bias. The results of this study were consistent with their expectations regarding the different instruments and the subtlety of the bias.

On evaluation forms which contained few, or even as little as one, questions regarding stereotypes, the evaluators were less likely to judge the software as containing bias. When the subjects employed the Expanded Sexism Checklist (ESC), developed by the authors, they evaluated the same software, previously evaluated as stereotype-free, as containing bias. This study has brought to the forefront a need for better software evaluation by those who plan to implement it.

The issue of software evaluation was examined again by Benoit and others (1991). They conducted a survey of career-oriented and educational software to evaluate the extent of gender bias. They found, by

identifying stereotyped representations of women, that the software they examined contained gender bias. They also found that older software was more likely to contain gender bias then software published more recently.

As a means of overcoming this obstacle, the authors recommend that software authors implement the "publisher-established non-sexist writing standards for textbook authors." (Benoit et al., 1991) This approach, although original, is subject to some difficulty. It does not take into account the authoring systems and programming that amateur software developers utilize. Hence, there would be a gap in the software used in the classrooms, dependent upon the developer's standard.

Form

Although biased software can be viewed as the primary concern in educational computing, there are other issues. Regardless of the content of the software, students may be exposed to stereotyping in the most elementary form of the computer. This includes the students' approaches to computing and programming languages and the overall computing atmosphere, which is generally associated with mathematics and science departments.

Sherry Turkle (1984) examined the way that boys and girls approach computer programming. The views of males, who tend to see programming as a logical activity, have dominated what is taught in introductory computer courses. This approach is generally accepted as "good" programming. Turkle has found however, that the sexes approach programming very differently and identified these differing approaches as part of the difficulty young girls encounter when learning programming. The boys tended to program by a highly valued top-down approach, which requires breaking the task down into smaller tasks and the prior planning of each of these individual tasks. The girls, on the other hand, tended to approach programming with what the author calls a "soft mastery" approach, which involves negotiating with the computer at the design level. Because most young girls are discouraged from using this approach, they come to reject programming. But, as Turkle (1984) stated:

> "Thus, some girls who reject programming are not rejecting the computers as such or programming as such. They are rejecting an intellectual style that has become indissociable from it in the public mind and the minds of teachers." (p. 49)

The author goes on to draw parallels between computer science and other sciences where hard mastery is the preferred and the "hard masters" define the field. She challenges that if given the opportunity to explore the computer in their own unique way, girls may open the door to the study of other formal systems, such as mathematics and science.

The conclusions that can be drawn from this research is that girls prefer not to use computers when they are generally associated with mathematics and science. Allowing girls to learn computing in their own style will give them the necessary success to move forward in other areas. In this regard, Sherry Turkle viewed computers as the gateway for women into mathematics and science. Conversely, Suzanne Damarin (1989) viewed mathematics as the gateway into computers. She resolves that given the opportunity to practice the necessary mathematical skills, girls can be successful in computing.

Suzanne Damarin (1989) sees the affect computers have on women both in school and in the workplace as a result of their inexperience with computers, which is largely due to the mathematics which is involved in their use. The large numbers of women that leave mathematical, scientific, and computer studies, coupled with the fact that mathematics and formal logic are central to the computer's functioning, brings Damarin to urge that young girls be given the opportunity to learn about and practice these skills.

Damarin then identifies two factors which must be taken into account: affective equity and evaluation equity. The former requires that instruction be mindful to the "attitudes, feelings, and preferences" of students. The latter encourages a move away from placing value upon a narrow set of answers toward "the diversity of ways in which computers, math, and science can be understood, used, and employed" (Damarin, 1989). In the computer classroom, this means placing value on the good qualities of a program, instead of placing value on "good" programming.

One of the suggestions for the overcoming of this obstacle is to introduce girls into the world of computing as a whole. This is based on the hypothesis that if girls are comfortable in the culture of computing, they will be more successful. Corlann Gee Bush (1983) suggested that analyzing the very personal context of technology use, including the use and discussion of computing in the user's terms, would allow for a rethinking of the user context, and would result in an "understanding of the effects of technological change on women's lives." (p.160).

The context of computer usage has become more personal over time as the trend in many schools today is the introduction of the computer into many content areas, and even as a stand-alone subject. This provides many opportunities for students to find and become comfortable with computing. As a result, there is a shift away from the direct association of computers with mathematics and science, yet the gender differences persist.

In 1985, Kiesler and Sproul further examined this conflict. The authors found that while there was increasing availability of computers in society, there was not equal usage by all. The authors attributed this disparity to the perception of computing as a culture. It is because of the existence of this culture that computer training should include lessons on living within this culture, as well as skills and knowledge. As it existed at the time of the writing, computing was male dominated and typically transmitted through males both in and out of schools. The authors stated that as long as girls are unfamiliar with this culture, they will remain unfamiliar with the hardware. Furthermore, since they do not believe that there is anything intrinsic that would make computers more difficult for girls, they see a need for software which allows all children to have computer ability.

Usage

Third, there is a cause for concern in usage, both qualitatively and quantitatively. While some students may have difficulty getting close to a computer physically, others may find it difficult getting close intellectually. This barrier can be created by a variety of situations, among them are the way in which computers are introduced and how they are used in the learning environment.

Patricia Campbell (1984) examined usage/access concerns and she found that while approximately half of all students are female, two-thirds of the students learning computers are male. These figures generally hold true in and outside the classroom. Campbell suggested that the way that computers are introduced is a contributing factor to these differences.

First, computers were often viewed as "math machines" and therefore any math anxiety students may have had was transferred to the computer. Also, teachers typically used boys to help introduce the computer to the class. This was due to the perception that boys have prior experience with computers, or are viewed as more mechanical. Lastly, where there are limited computers for a large group of students, the more aggressive students, typically the males, used the computers.

As a result of the combination of these factors, young girls were using computers less than their male counterparts. As more people, especially teachers, became aware of these differences, girls gained physical accessibility to the hardware and software. The focus then became an examination of deeper issues.

Jan Hawkins (1987) examined the reports from various research endeavors regarding gender and computers. She found that both the organization of the learning and the role the computer played in the learning environment influenced computer use by males and females. Due to the link between computers and mathematics and science, the computers were often integrated into one of these areas. The result was that girls encounter difficulty utilizing the computers because of the view of these areas as male domains.

Other research Hawkins examined, studied the role of nature, nurture, and society at large in influencing girls use of computers. The general conclusions were that the characteristics of a task heavily influence the amount girls used the computers. Again, girls were less likely to use computers when programming was being taught, but were more likely to use them when word processing was the central task. In regards to mathematics and science software, girls preferred those that allowed students to work cooperatively and the goals of which were not blatantly scientific.

These articles were written early in the computer-education relationship and the authors urged the readers to be aware of the formation of stereotypes because it was early enough to curb them. As access and usage increased there was a shift away from concerns regarding only the amount of time which was spent on computers. One study which was under way at the time found that even as students used computers more and had increased exposure to them, the differences in attitudes between the sexes did not significantly change. (Krendl et al., 1989) On the contrary, confidence and interest in computers by girls were unaffected by time. It became an issue of benefit equity, people began to examine why gender differences persisted even as the amount of time using computers leveled out.

Lockheed (1985) examined why women and girls were not using computers and attempted to explain why. She resolved that the disparity was due to the differences in the ways in which boys and girls use computers. And the manner in which they are using them has led to the defining of computing as a male domain.

As was stated in much of the research on the issue of usage, boys are more likely then females to use the computer for game-playing and programming. (Lockheed, 1985) Conversely, when the computer was used for other applications, there were little or no differences in use by gender. Unfortunately, much of what is viewed as valuable computer use is programming, resulting in the de-emphasizing of girls use of computers.

In the article "The Computer Gender Gap: Children's Attitudes, Performance, and Socialization" the authors examine gender differences in terms of access and performance outcomes. (Nelson & Watson, 1990-91) While there has historically been gender differences in education, the question remains of whether the new technologies, i.e. computers, will diminish or perpetuate existing gaps. Since the introduction of computing into all areas of school, the authors believe the transference of math anxiety to the computer has decreased. What are now viewed as the differentiating factors are the influence of the family, gender bias in the software, and the influence of the teacher.

Conclusions

From the research examined, three key inferences may be drawn in regards to interaction with computers, research methods, and research questions. The writings, dating from 1983 - 1993, examined in this analysis contain a recurring call for varying types of educational computing experiences. These would allow for differing ability and interest levels, as well as varying types of interactions. (DeVaney, 1993; Ellsworth, 1988; Rosenthal et al., 1988; Campbell, 1984; Nelson et al., 1990-1)

Also threaded throughout these readings is a common research methodology. Most of the examinations of software content and computer usage were studied through the standard research methods such as controlled studies (Rosenthal et al., 1988; Huff et al., 1987), surveys (Demetrulias, 1985; Krendl et al., 1989; Lockheed, 1985), and observations (Kiesler et al., 1985).

Also evident in these readings are research questions which vary in their approach. As the discrepancy between gender and computing came to the surface, the initial issue was how the hardware was being used in the classrooms (Demetrulias, 1985; Hawkins, 1987; McInerney et al., 1986). This approach addressed issues of accessibility to computers and equal usage time by both sexes. As this concern was identified and then resolved, it became apparent that there were other concerns to be addressed.

Researchers (Biraimah, 1989; Rosenthal et al., 1988; Benoit et al., 1991) began focusing on the software which was being currently utilized in classrooms. Their findings, discussed earlier, established a concern for the content of this software. Many software packages were found to have varying degrees of stereotyping and bias within them.

Finally, others studied the context in which the hardware and software were being used (Krendl, 1989; Ellsworth, 1988). These studies found that the environment in which the computer was used, regardless of equal access and representation in software, effected the performance of students in regards to their gender.

The culmination of these various writings has come to the current emphasis for an examination of educational computing from a social/societal perspective rather than a technological one (Huff et al. , 1987; Kiesler et al., 1985). As has been the history of the gender-educational computing field to be reactive to such concerns, addressing this relationship through new methods may help to identify and resolve, or perhaps prevent further areas of conflict. The continuing growth of the field allows for such a change in perspective in further studies.

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