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Educational Computing as a Social Practice

Hank Bromley and Michael W. Apple, editors

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Edited by Hank Bromley and Michael W. Apple

CHAPTER 5

"I Like Computers, But Many Girls Don't": Gender and the Sociocultural Context of Computing[1]

BRAD R. HUBER and
JANET WARD SCHOFIELD

> It seems more logical to call them *computadoras* [feminine form for 'computers'] than *computadores* [masculine] in light of the subtle and mysterious enchantment found in all feminine words.[2]
>
> —Alvaro Montoya Gomez, author of "El eterno feminino," an article that appeared in a Costa Rican computer journal (1990:22)

Introduction

This paper examines differences in the way boys and girls think about and use computers at Escuela San Juan,[3] a Costa Rican primary school. Students at Escuela San Juan generally have positive attitudes toward LOGO programming, computers, and the computer lab. However, girls as a group like LOGO less, are less confident of their ability to use computers, and are more anxious about the lab environment than boys. Student competition in the lab, stereotypes about programming, the level of assistance students receive, and amount of prior computer experience are related to these gender differences in attitudes.

San Juan's "computer culture" is best understood within the broader context of pervasive gender-linked stereotypes and social patterns found at this school and in Costa Rican society at large. As is the case with cultures around the world (Williams and Best, 1982), the idea that males and females have different personalities and aptitudes is fairly widespread in Costa Rica. These gender stereotypes are transmitted by socialization practices, the radio, television, popular magazines, school textbooks, and other means. They shape

patterns of political office holding, familial roles, occupational choice, and scientific and technical training.

In this chapter, anthropology's holistic perspective is used to understand the complex ways in which these variables are interconnected and interrelated (see Mehan, 1989; Motherwell, 1988; Papert, 1987; Turkle, 1984; Turkle and Papert, 1990). It is clear that student attitudes toward computers are profoundly influenced by the cultural and social forces mentioned above. Moreover, this study suggests that the computer labs in Costa Rica's schools may help to maintain and reproduce this country's gender status quo.

The research reported below has a number of theoretical, methodological, and practical implications. First, our work represents an effort to determine whether theory and findings based upon research undertaken primarily in the United States generalize to a somewhat different cultural setting. As Huberman (1987:12) found, research conducted in the United States may be "right on the nose" in helping to elucidate certain phenomena in other cultures but prove to be unproductive in others. Second, journals such as the *Logo Exchange* give every indication that educational computing programs similar to Costa Rica's will have a significant impact on students in Latin America. Social scientists, educators, and policy makers who are developing and implementing programs for these students may find our work useful for practical reasons. Third, previous research on gender and attitudes toward computers has for the most part been exclusively quantitative. This research has been very fruitful. Frequent reference is made to it as well as to a quantitative time allocation study and survey research conducted at a second Costa Rican primary school. Nevertheless, the qualitative research undertaken at Escuela San Juan allows us to "flesh out," evaluate, and clarify previous explanations for gender-related differences in this domain.

This paper is organized in the following manner. First, the research methods employed in the study reported here are discussed. This is followed by an overview of Costa Rica's educational computing program in primary schools and the sociocultural context in which it is embedded. The main body of the paper examines in detail the attitudes San Juan's girls and boys have toward LOGO and some of the reasons girls have less positive attitudes than boys. The conclusion discusses the findings and the more general conceptual and pragmatic issues they raise.

Research Methods

Escuela San Juan is a twenty-five year old public primary school located in a working and middle class suburban neighborhood in the city of Heredia.

Heredia, with a population of approximately 79,500 people (Trejos, 1991, p. 243), is one of three small cities surrounding San Jose, Costa Rica's capital. There are approximately 945 students who attend this school's morning and afternoon sessions. Ethnically, almost all of San Juan's students and teachers identify themselves as white. Thirty-three teachers, twenty-nine of whom are women, teach kindergarten and grades 1–6. The school has a male principal.

San Juan's students started using the Spanish version of LOGOWRITER during the fall of 1989, approximately seven months before research was begun. LOGOWRITER (Version 2.01) has both programming and word processing capabilities. Some of the most capable older students develop fairly sophisticated projects that combine color graphics, animation, and text, such as representations of the hydrological cycle with clouds, rain, mountains, and the sun; diagrams of different types of triangles with accompanying descriptive captions. Younger, less accomplished students create simple geometric forms, houses, flowers, cars, and soccer fields.

In general, students are given considerable freedom to develop projects of their choice (Aguilar, Alvarado, Calderón, Fallas, Hernández, Pereira, Ramírez, and Vargas, 1989; Chacón, 1989). During the course of working on LOGO projects, it is hoped that students will become familiar with the computer and some of its applications, acquire a positive attitude toward science and technology, better understand mathematics, the sciences, and Spanish, and develop new reasoning and problem-solving skills. Learning to program in LOGO is seen as a means to achieve these goals rather than as an end in itself (Badilla-Saxe, 1991; Fonseca, 1991, 42, p. 75).

San Juan's LOGO lab has twenty computers. Generally, the thirty to forty students in the lab work in pairs. The students' lab work is facilitated by a lab teacher and their regular classroom teacher. Typically, the lab teacher introduces new LOGO commands to students during the initial five to ten minutes of class. Afterwards, students enter their passwords into the computer and begin programming. They are allowed to work at their own pace, though the teachers do reprimand students when they are making little or no progress on their projects.

During the summer of 1990, the first author observed student-teacher and peer interactions at Escuela San Juan. Computer labs and classrooms were observed four days a week for eight weeks. On each of these days, one eighty-minute session in the computer lab was observed. A kindergarten, second, fourth, and sixth grade class were selected for observation. In addition, the same groups of students were observed once each week for eighty minutes in their regular classrooms, where they learned about mathematics, Spanish, and the natural and social sciences. Field notes on lab and classroom interactions

were made at the time they were being observed. These notes were written up in expanded form one to three hours after each observation.

In addition, semi-structured interviews were administered in Spanish to San Juan's three lab teachers, and to six sixth grade and six fourth grade students. Three boys and three girls were interviewed from each grade. An additional sixth grade boy who assisted a lab teacher with one or two classes each week was also interviewed. According to other students and the lab teachers, the students who were interviewed were among the best programmers at San Juan. The criteria used to select these students included: (1) the boys and girls should be roughly comparable with respect to their level of programming proficiency, and (2) their attitudes must be solidly grounded in experience.

The majority of the students interviewed came from middle-class households, consistent with the preponderance of middle-class students in the student body. Although the sample of students interviewed here is too small to permit meaningful comparisons between students from different social class backgrounds, it is striking that the gender-linked patterns discussed in the later part of this paper were very apparent in the interview data, since scholars have noted that the *machismo-marianismo* complex, a constellation of gender-related stereotypes and behaviors discussed in more detail below, appears to be somewhat less pronounced among the middle than the working class (Biesanz, Biesanz, and Biesanz, 1988, pp. 96–97, 108; Méndez Barrantes, 1988, p. 40).

Clear and consistent patterns emerged upon analysis of the lab observations and interviews. San Juan's girls and boys think about and use computers differently. This conclusion, derived from analysis of the qualitative data gathered at San Juan, is also consistent with quantitative data collected during a ten-week period in 1992 at Escuela Pérez, another primary school in Heredia with the same program and very similar facilities (Huber and Scaglion, 1995). At Escuela Pérez, a time allocation study was undertaken to determine how lab and regular classroom teachers allocate their time with computer lab students. Four groups of fifth graders and five groups each of first, second, third, fourth, and sixth graders were observed in the lab. Observations of teacher-student interactions were made every five minutes for each of the twenty-nine groups, for a total of 388 observations. Student attitudes toward LOGO programming and Escuela Pérez's lab environment were also investigated by administering a questionnaire to 262 students: two groups each of third, fourth, fifth, and sixth graders. Although a detailed report on the complete findings of this study is beyond the scope of this paper, some reference will be made to this study when it clarifies issues that arose at San Juan.

Costa Rica's *Programa de Informatica Educativa*

Democracy, peace, and education have long been cherished in Costa Rica, a small Central American nation of approximately three million people. "We have more teachers than soldiers" was frequently heard even before Costa Rica's armed forces were officially abolished in the late 1940s (Biesanz et al., 1988, p. 9). By the mid-1980s, a large percentage of children regularly completed nine years of schooling, and many new public and private schools and universities with modern facilities were operating in rural and urban areas (Pacheco, 1986; Wahab, 1983, p. 2). Costa Rica engages 27 percent of its population as teachers and students, assigns a sizable proportion of its national budget to public education, and has a 93 percent literacy rate (Asociación Demográfica Costarricense, 1984; Biesanz et al., 1988, pp. 114, 220; Institute of International Education, 1986, p. 34; *The Tico Times*, 1989, p. 21).

The integration of computers into the primary school curriculum is one of the most visible ways in which Costa Rica is attempting to enhance its educational system (Biesanz et al., 1988, p. 220; Wahab, 1983, p. 4). After Oscar Arias Sanchez became president in 1986, Costa Rica began to create computer labs in nearly two hundred of its primary schools. Its educational computing program,[4] known as the Programa de Informática Educativa, is financed through private enterprise and national and international agencies, supported by Costa Rica's Ministry of Education, and coordinated by the private, nonprofit Fundación Omar Dengo (FOD). It is under the tutelage of Seymour Papert, a leading figure in computers and education, and developer of LOGO (Dyer, 1988, p. 12; Fonseca, 1991, pp. 69–84).

In 1988, computer labs of twenty IBM PS-2 computers were set up in sixty primary schools. An additional seventy labs were established by 1990. Thirty more are scheduled for the near future. When the third set of laboratories are in place, computers will be located throughout the country and be accessible to 134,500 students—32 percent of the elementary school population[5] (Chen Quesada, 1992; Fonseca, 1991, p. 55; Harper, 1991, p. 43; *La Nación*, 6 July 1992, p. 8A).

Gender Roles in Costa Rica: Escuela San Juan's Sociocultural Context

In Costa Rica, male and female roles and relationships are strongly influenced by the machismo-marianismo complex. Machismo is the belief that males will excel in intellectual matters and dominate social relationships involving the opposite sex. Males are often characterized as dominant, authoritative, ratio-

nal, independent, and interested in politics, sports, mathematics, and science. Marianismo refers to female submissiveness and superiority in spiritual and moral matters. Women are frequently seen as soft, sweet, obedient, intuitive, interested in the home and child care, compassionate, pious, decent, and pure (Biesanz et al., 1988, p. 90; Méndez Barrantes, 1988, pp. 36–37; Romero, Osorio, Piza, Crespo, León, and Montero, 1986, pp. 44, 170).

These gender stereotypes are transmitted in many ways. Men and women are often portrayed in a manner consistent with the images described above in Costa Rican radio programs, television shows, commercials, popular magazines, and programs and materials developed by governmental and nongovernmental agencies. Gender stereotypes are also found in primary school textbooks. Over 70 percent of school book illustrations and textual material is devoted to male historical figures, professionals, scientists, and technicians. Women most often appear as teachers or housewives; illustrations of girls playing house or with dolls are also common. Stereotyping is found in textbooks for all elementary school grades but is most evident in fourth, fifth, and sixth grade books (Abramovay, Ramírez Quirós, and Damasco Figueredo, 1991, pp. 83, 229–44; González Suárez, 1988a, pp. 603–07, 1988b, pp. 19–22; Quirós and Larrain, 1977, p. 78).

Popular computer magazines available in Costa Rica also often portray women and girls using computers in a stereotypical manner. In July 1992, Costa Rica's two largest retailers of books and magazines (La Universal and Librería Lehmann) sold titles familiar to those interested in computing in the United States, such as *PC Magazine*, *BYTE*, *PC World*, and *Personal Computing*. Relatively recent studies of such computing magazines, including *BYTE* and *Personal Computing*, have concluded that women appear in illustrations with computers less frequently than men, and when they do appear, they are often depicted as clerical workers and sex objects. In contrast, men are more often depicted as managers, experts, technicians, and in active "hands-on" roles. These studies conclude that students, teachers, and parents who read these magazines are likely to come to associate the use of computers with males (Demetrulias and Rosenthal, 1985, p. 93; Levin and Gordon, 1989, p. 86; Sanders and Stone, 1986, p. 7; Ware and Stuck, 1985, pp. 211–13).

The placement of these magazines in Costa Rica's book stores reflects this association. For example, at Librería Lehmann they are found next to magazines dealing with cars, stereo equipment, electronics, science, skin diving, and model building, rather than near magazines on topics such as cooking, sewing, and parenting, clearly reflecting the retailer's association of computers with males.

Gender stereotypes influence many kinds of behavior, such as political

office holding and occupational choices, with men in Costa Rica typically being much more likely to hold positions of power and authority. Although Costa Rica recently had a female vice president and a female president of its Legislative Assembly, men continue to hold most political posts. From 1953 to 1986, 91–99 percent of the fifty-seven deputies in the Legislative Assembly were men. A similar level of male office holding is found in Costa Rica's political parties, municipal councils, and community associations (Hernández, 1990–91, p. 125; Méndez Barrantes, 1985, p. 42; 1988, p. 41; Romero et al., 1986, pp. 191–94).

Turning to occupations, we find that over 75 percent of women are classified as housewives. Of the approximately 25 percent classified as economically active in 1980 (that is, female wage earners), most worked in personal services (such as cooks, maids, waitresses, janitors, seamstresses) or were employed as primary and secondary school teachers, nurses, typists, secretaries, beauticians, and hairdressers. The average wage earned by women is substantially less than that earned by men, even when men and women perform the same work (Abramovay et al., 1991, pp. 49, 60; Casasola, Morera, and Obando, 1983, pp. 32–33; González Suárez, 1977, p. 32; Guzmán, 1983, pp. 14–16; Méndez Barrantes, 1985, pp. 41–42; Romero et al., 1986, pp. 196–97).

A similar pattern is found in Costa Rica's educational system. Most preschool (98 percent), primary school (79 percent), and secondary school teachers (54 percent) are women. Higher paying and more prestigious roles in the educational system, such as university professors and administrators, primary and secondary school principals, and regional directors, are typically filled by males (Abramovay et al., 1991, p. 82; González Suárez, 1977, pp. 33–41; Méndez Barrantes, 1988, p. 38).

Gender also helps to shape enrollment patterns for Costa Rica's students. More men than women pursue an advanced degree at Costa Rica's major universities. Male and female university students also tend to select different majors. Men predominate in the natural sciences, law, engineering, economics, business, and educational administration. Women tend to major in the social sciences, arts and letters, nursing, and education (Chavarría González, 1985, p. 92; Méndez Barrantes, 1985, p. 41; 1988, p. 38; Mendiola, 1988, p. 87).

With respect to computer science, 70 percent of the 1991 graduates of the Universidad de Costa Rica's computer science programs were men (Oficina de Registro, Universidad de Costa Rica, 1991, p. 24; cf. Chavarría González, 1985, p. 92). Of the 471 students enrolled in July 1992 at the Universidad Nacional's School of Computer Science, 68 percent were male (Floyd Gray, personal communication). Approximately 54 percent of the 1075 students

recently admitted to the Instituto Nacional de Aprendizaje's Computer Science Center were men (*La Nación*, 24 July 1992, pp. 34A–35A).

Differences in the proportion of men and women enrolled in these computer science programs may reflect a division into a higher status tier dominated by men and a lower status tier populated by women. The Universidad de Costa Rica and Universidad Nacional are two of this country's most prestigious universities, from which many top scholars, administrators, and educators come. The Instituto Nacional de Aprendizaje provides students with one to two years of training in a number of technical fields.

An emphasis on gender as an important attribute which can appropriately be used in organizing activities is apparent in Costa Rican secondary and primary schools in general, and at San Juan in particular, although the formal school curriculum is very similar for males and females. For example, secondary school boys are much more likely than girls to enroll in industrial arts and technical schools, while girls are more likely to take family life and art classes (Abramovay, Ramírez Quirós, and Figueredo, 1991, p. 83; Romero et al., 1986, p. 198). In addition, Costa Rica's Ministry of Education has a dress code that requires male secondary and primary school students to wear shirts and pants and girls to dress in blouses and skirts. At Escuela San Juan the division by gender is also apparent in a wide variety of contexts. For example, the physical education teacher often forms same-sex basketball teams and may have girls and boys play against each other. Teachers also give blue report cards to boys and pink cards to girls.

Numerous practices of the students' teachers encourage sex segregation of San Juan's computer lab (and most classrooms). Teachers transferring students between their regular classroom and the lab have students form two lines, one of boys and another composed of girls. In addition, students who were interviewed mentioned that they were allowed to select their own lab partners. Since Costa Rican students of this age generally have same-sex friends, the pairs working in the lab virtually always had gender in common. Furthermore, students were allowed to decide where they would sit in the lab, resulting in a seating pattern with boys on one side of the lab and girls on the other.

In sum, San Juan's students and teachers are living in a society which perceives males and females as having quite different personal abilities and personalities and which encourages males to hold political and administrative posts, work outside the home, and acquire advanced scientific and technical training, including training in computer science. Since many of the patterns are similar to those documented in the United States, it should not be too surprising that this study uncovered a number of parallels between the way in which boys and girls in the two countries view computers.

Gender Differences in Students' Attitudes Toward Computer Activities

A considerable amount of research has been undertaken in the United States, Canada, the United Kingdom, Australia, and Israel on gender and attitudes toward educational uses of computers. Findings from these studies are generally quite consistent regardless of the nationality of students and teachers. However, it must be pointed out that the range of cultural variation covered in these studies is quite limited, since the vast majority have been conducted in English-speaking countries which share strong historical ties and cultural roots.

Most researchers report that girls have more negative attitudes towards computing than boys. However, this does not mean that the girls' attitudes toward computers are negative in an absolute sense nor that boys' and girls' attitudes are radically different. As will be discussed in more detail below, a careful examination of the findings of prior research shows that both boys and girls generally like computers, are confident of their ability to use them, and experience little anxiety performing computer-related tasks. Thus, it is more accurate to say that most boys and girls have positive attitudes toward computing, with the girls' attitudes being somewhat less positive than those of boys. This general finding was parallel to our findings at San Juan primary school for the three attitudes discussed below: computer liking, confidence, and anxiety.

Computer Liking

Computer liking—how much one enjoys and is interested in computing—has been investigated by a number of scholars. Hawkins (1985, p. 172) found that third and sixth grade girls in the United States like LOGO programming less than do boys (see Mawby, Clement, Pea, and Hawkins, 1984, p. 8). The majority of researchers who have investigated other educational uses of computers report a similar pattern (Abler and Sedlacek, 1987, p. 166; Chen, 1986, p. 273; Colley, Gale, and Harris, 1994, p. 132; Collis, 1985, p. 33; Collis and Williams, 1987, p. 22; Johnson, Johnson, and Stanne, 1985, p. 674; Kay, 1989, p. 312; Krendl, Broihier, and Fleetwood, 1989, p. 90; Levin and Gordon, 1989, p. 75; Miura, 1987, pp. 307–08; Okebukola, 1993, p. 184; Shashaani, 1994, p. 438, 1995, p. 35; Wilder, Mackie, and Cooper, 1985, p. 218; Woodrow, 1994, p. 319).

Some studies, including an analysis of the Computer Attitude Scale administered at Escuela Pérez, have found no statistically significant difference in how much boys and girls like computers (Busch, 1995, p. 151; Col-

bourn and Light, 1987, p. 134; Dyck and Smither, 1994, p. 246; Francis, 1994, p. 286; Hawkins, 1985, p. 177; Loyd and Gressard, 1984, p. 76; Robertson, Calder, Fung, Jones, and O'Shea, 1995, p. 77). However, Loyd and Gressard (1984, p. 75) did find that the boys' mean score was somewhat higher than the girls'. Further, students who participated in Colbourn and Light's (1987, pp. 138–39) and Hawkins's (1985, pp. 177–78) research were found to have collaborated extensively while using computers at school. Since investigators report girls prefer collaboration and cooperation to competition, their finding of no difference is not surprising. This issue is discussed in more detail below.

A few researchers have suggested that girls as a group have more positive attitudes toward some computer activities than boys (DeRemer 1989, p. 45; Hawkins, 1985, p. 177; Loyd, Loyd, and Gressard, 1987, p. 18; Williams and Rosenwasser, 1987–89, p. 59). However, Loyd et al. (1987, p. 18) report that girls with one or more years of computing experience actually like computers less than comparably experienced boys (cf. DeRemer 1989, p. 48). In Williams and Rosenwasser's (1987–89, p. 59) behavioral measure for computer interest, how frequently students approach and work on the computer may account for their unusual finding. Since students often had to wait in line to use the classroom computer, "it may be that willingness to wait, or patience, was being measured in addition to computer interest *per se*." Thus, we conclude, as does Sutton (1991, p. 490) in a review of this literature, that the preponderance of the evidence suggests boys tend to like computers better than girls.

The majority of the boys and girls who were interviewed at San Juan primary school like LOGO programming. With the exception of two sixth graders, a boy and girl, students say they prefer computer programming to their regular class work. Humberto, a sixth grade boy, was one of the most enthusiastic computer users. "I like computers a lot. . . . Anything that has to do with the computer and learning about the computer is very interesting. How it functions interests me. [So does its ability] to do so many things by itself [and] the way it stores so many things in memory." Some additional things students report enjoying include: (1) having the freedom to develop a wide variety of computer projects, (2) being creative and artistic, (3) being able to talk more in the lab, and especially (4) writing less and not having to take exams. Interestingly, features of the lab which students like are neither inevitable results of using LOGO nor, in principle, unobtainable changes in classrooms which do not use LOGO. Nonetheless, the utilization of computers in the classroom often seems to lead to such changes, even when achieving them is not part of the underlying rationale for use (Schofield, 1995).

Although all students expressed enthusiasm about using computers in the lab, the girls seemed to like LOGO somewhat less than the boys. For example, when asked to indicate their favorite subjects, four boys named computing and a fifth included computing among his top three subjects. This contrasts sharply with the responses of the girls, none of whom said computing was their favorite subject. In fact, only one girl, a sixth grader named Laura, mentioned computing at all, and it was her third choice. She liked home economics best, with religion a close second.

Observational data gathered in the computer lab are consistent with the view that boys like lab work more than girls. Boys are generally more eager than girls to begin working on the computers. The following observation of kindergarten students is typical of students entering the lab.

> [The kindergarten students] line up outside the door. Maestra Andrea lets the girls enter first. The boys enter second. The first five or six boys run to their seats. The [lab] teacher scolds them and makes them go back to the door. She says they must walk to their seats.

In general, boys are also more reluctant to stop working on their lab projects than girls. They are usually the last to leave the lab. In addition, it is not uncommon for some boys to remain after class to continue working on their projects. In contrast, it was frequently observed that some girls quit working on their projects five minutes before the lab period ended. The following observation of a fourth grade class illustrates these general points.

> Before the bell rang, several girls grabbed their notebooks and stood about a meter [inside the lab] door, milling around and talking. When the bell rang, [they and most of the remaining] students . . . filed out of the room. [However], Nestor was one of [several] boys who remained working. Maestra Victoria went around the room preparing the computers for the next class and saving the students' work [to disk]. Javier and Randall came into the lab to work, but [on this occasion] the [lab] teacher asked them to leave.

In contrast, no gender differences were observed with respect to students entering or leaving their regular classrooms or remaining in them during recess.

Boys also more frequently go to the computer lab during recess than girls. It was rare for a girl to be among the one to eight students present in the lab during recess. Moreover, boys and girls reported going to the lab during recess for different reasons. Boys often reported working on their projects during recess. The two girls who go to the lab do so for other reasons. Johanna confides, "I go to the computer lab during recess because I have almost no one else to be with. Sometimes [my friends] gossip and [this] angers me. [Recess] is boring, so I go to the computer lab." Milena appears to go to the lab because

she's curious, not because she wants to program. "Sometimes I go to the lab during recess to see the designs the other groups [of students] are making." Jokingly she adds, "Their designs certainly are ugly."

As was previously indicated, an analysis of the Computer Attitude Scale administered at Escuela Pérez found no statistically significant gender differences in liking computer lab activities. Differences in the way students used computers at these two schools may account for this inconsistency. For example, the word processing feature of LOGOWRITER was used more extensively by Pérez's students than by San Juan's. The work of Hawkins (1985, p. 176) and Wilder et al. (1985, p. 219) suggests that girls like writing and word processing as much as or more than boys. Another difference between San Juan and Pérez concerns the use of the computer lab during recess. At San Juan, boys dominated the lab during this time. This undoubtedly contributed to their being more confident and interested computer users than girls. It would also tend to confirm stereotypes that link computers with boys. In contrast, Pérez's lab was closed during recess. As a consequence, girls had a somewhat more level "playing field" at this school than they did at San Juan.

Computer Confidence

Female students of all ages have generally been found to be less confident of their ability to use computers than males (Busch, 1995, p. 151; Chambers and Clarke, 1987, pp. 513–14; Chen, 1986, p. 273; Clarke and Chambers, 1989, p. 424; Colley et al., 1994, p. 132; Collis and Williams, 1987, p. 22; DeRemer, 1989, p. 45; Hattie and Fitzgerald, 1987, p. 10; Johnson et al., 1985, p. 674; Levin and Gordon 1989, p. 75; Miura, 1987, pp. 307–08; Robertson et al., 1995, p. 77; Shashaani, 1994, p. 438, 1995, p. 35; Smith, 1986, p. 341; Temple and Lips, 1989, p. 221; Wilder et al., 1985, p. 226; Woodrow, 1994, p. 319). Several researchers, including DeRemer (1989, pp. 45–46), Dyck and Smither (1994, p. 246), Francis (1994, p. 286), Koohang (1989, p. 141), Loyd and Gressard (1984, pp. 75–76), and Loyd et al. (1987, p. 17) found no statistically significant gender differences in computer confidence. However, males who participated in the first three of these studies did have higher mean computer confidence scores than females. In addition, Loyd et al. (1987) found that among those students with six or more months of computer experience, girls were less confident than boys. We are not aware of any study that found girls to be more confident of their computing abilities than boys. Thus, existing research suggests a gender-linked difference in computer confidence.

The Costa Rican students who were interviewed are generally confident of their ability to program in LOGO. However, boys are generally more confident than girls. All of the boys who were interviewed think using LOGO is very easy. The comments made by Nestor, a fourth grade boy, are typical. "Computing is easy because I like it. [In contrast], when I don't like a subject, I don't want to learn it . . . I always know what I'm doing [in the computing lab]." Humberto, a sixth grade boy, was the only boy to acknowledge he ever found lab work difficult. "In the beginning, [computing] was difficult, but now it's easy."

In contrast, girls are far from unanimous in claiming confidence in their computer abilities. Although two of the girls asserted LOGO programming was easy, including one who thought it was very, very easy (facilisimo), the majority rated their computing abilities more modestly than the boys. They perceived computing to be "more or less difficult," "difficult, but interesting," and "easy, more or less." None of the boys acknowledge that LOGO programming is difficult, though all of the students, regardless of gender, say they make mistakes or need assistance from time to time.

An analysis of the Computer Attitude Scale administered at Escuela Pérez also shows that students are generally confident of their ability to program, but that boys are significantly more confident than girls. Specifically, girls are more likely than boys to indicate that they experience difficulty in developing computer projects. Additionally, girls are more likely to report having problems entering text.

Computer Anxiety

The final type of computer attitude to be discussed here is that of computer anxiety—fear of using or learning to use computers. Research on gender differences in computer anxiety most often shows that females are more anxious than males. This has been found for primary and secondary school students and undergraduates (Abler and Sedlacek, 1987, p. 166; Busch, 1995; Chen, 1986, p. 273; Colley et al., 1994, p. 132; Hattie and Fitzgerald, 1987, p. 13; Igbaria and Chakrabarti, 1990, pp. 232–33; Liu, Reed, and Phillips, 1992, p. 460; Okebukola, 1993, p. 184; Wilder et al., 1985, p. 225; Woodrow, 1994, p. 319) and for elementary school children using LOGO (Siann, Macleod, Glissov, and Durndell, 1990).

Campbell (1988, p. 115), Dyck and Smither (1994, p. 246), Francis (1994, p. 286), Kinnear (1995, p. 32), Koohang (1989, p. 141), Loyd and Gressard (1984, p. 76), Robertson et al. (1995, p. 77), Robinson-Staveley and Cooper (1990, pp. 175–76), and Schumacher, Morahan-Martin, and Olinsky (1993, p. 188) found no statistically significant gender differences in the level of computer anxiety for elementary, secondary, and college students. However, the mean anxiety scores of the males are lower than the females' in Koohang's, Loyd and Gressard's, and Robinson-Staveley and Cooper's

research. In addition, Campbell (1988, p. 109) notes that computers were not used extensively by the majority of students with whom she worked. Thus, the sorts of in-school experiences that may lead to girls being more anxious about computers could not have been very frequent.

Campbell (1990, p. 496) and Loyd et al. (1987, p. 17) conclude that secondary school girls are less anxious about computers than boys. However, Campbell's conclusion would appear to be mistaken since the computer anxiety scores reported in her paper support the opposite conclusion (1990, p. 492, Table 1). With respect to the Loyd et al. (1987) study, it is once again worth noting that girls with the most experience using computers are actually more anxious than boys with similar levels of experience. In conclusion, when there are gender differences in this domain, boys tend to be less anxious about computers than girls.

There was little evidence of computer anxiety, as it is usually conceptualized, in the students interviewed at San Juan primary school. However, the reasons two girls gave for not using computers during recess do indicate some anxiety about the lab. Laura, a sixth grader, said, "I haven't gone to the lab during recess. I don't like doing that because afterwards they'll say a diskette was lost or something like that, and then the person who came to the lab during recess will be blamed. The teacher and students say things like this. They're lies." A fourth grade girl also reported reservations about going to the lab during recess. "I haven't gone to the computing lab during recess. I don't know if the teacher would allow that or if she would scold me." It is important to note that these girls' anxieties are not about programming *per se* but about possible interpersonal difficulties or criticism which might result from using computers outside of regularly scheduled lab periods.

Analysis of the Computer Attitude Scale administered at Escuela Pérez clearly indicates that girls are somewhat more anxious than boys about lab work. Though boys and girls report feeling very good in the lab and are not nervous about developing projects, girls are more anxious than boys when they correct programming errors. They also report being somewhat more afraid of damaging the computer than boys. Thus, like students in the United States, there is reason to conclude that Costa Rican girls are somewhat more anxious about computer-related activities than boys.

Factors Contributing to the Girls' Less Positive Attitudes Toward Computers

All educational computing programs, no matter how innovative and constructive, are implemented within a particular social and cultural context. Program

administrators and teachers have little direct control over this. Costa Rica's computerization program is no exception. In Costa Rica, cultural images of males and females embodied in the machismo-marianismo complex and reflected in the social and occupational structure of Costa Rican society impinge on students and shape their attitudes and behavior in many ways. Of course, it is also possible that the girls' less positive attitudes are due to specific attributes of the LOGO programming language itself, although no direct evidence supporting this view emerged from this study. This latter point is addressed first.

Male Biased Software

Much of the educational software currently used in classrooms contains features which make it more appealing to boys than girls. For example, software designers often devise game-like educational programs that use metaphors of war, sports, and space. These are areas in which males have traditionally had more involvement and interest than females (Huff and Cooper, 1987, pp. 527–30; Wilder et al., 1985, p. 223; see also Hawkins, 1985, p. 178; Hodes, 1995, p. 6).

Many boys at San Juan develop projects related to domains traditionally more of interest to males than females, such as sports. Similarly, girls often create images traditionally linked to female interests and domains, such as flowers or homes. However, the ways in which LOGO can be used and the kinds of designs and texts students can create are nearly unlimited. They depend more upon the student's imagination and preference than any limitation of the software program (Kiesler, Sproull, and Eccles, 1985, p. 460). A large number of case studies conducted in the United States by Motherwell (1988), Papert (1987), Turkle (1984), and Turkle and Papert (1990) shows that LOGO can appeal to many girls and boys as long as students are given an opportunity to program in a manner with which they feel comfortable. Moreover, Sanders and Stone (1986, p. 61) recommend that primary school instructors use LOGO in their classrooms precisely because of its appeal to both girls and boys. This is significant because, as their book shows, they are clearly aware of the gender biases often found in educational software.

Having said this, it is still possible that the LOGO programming language may be more appealing to boys than girls. Bowers (1988, pp. 62–63) contends that learning mediated by many kinds of educational software, including LOGO, emphasizes digital thinking. Digital thinking refers to storing, manipulating, and retrieving "mind-size bites" of information that have been abstracted from their context. Bowers argues that students use this mode of thinking during the course of mastering LOGO's commands and ordering

them in a linear and logical manner. Bowers also cites evidence that males more so than females are socialized to value and be comfortable with digital thinking. If it is assumed that students using LOGO must employ this style of thinking, then boys would be expected to have more favorable attitudes than girls. They would be engaging in their preferred way of thinking and knowing (Bowers, 1988, pp. 91–92). Although we have no evidence from this study which bears on this thesis, if Bowers is correct, this would be one other possible factor contributing to the differences we observed.

Competition and Domination of the Programming Process

A number of authors have suggested that girls develop unfavorable attitudes toward computers when they are used by students to compete. In contrast to boys who seem to enjoy a competitive lab environment, female computer users often appear to prefer collaboration and cooperation (Chambers and Clarke, 1987, p. 512; Clarke and Chambers, 1989, p. 425; Hawkins, 1985, pp. 176–77; Hoyles and Sutherland, 1989, p. 224; Johnson et al., 1985, p. 676; Kinnear, 1995, p. 35; Motherwell, 1988, pp. 48, 142; see Hativa, Lesgold, and Swisa, 1993, pp. 376, 395–98). These preferences are presumably the outcome of socialization patterns that lead boys to enjoy competition, control, and dominance, and girls to enjoy cooperation, negotiation, and nurturance (cf., Turkle and Papert, 1990, pp. 132, 150). Stereotypes and socialization practices prevalent in Costa Rica encourage similar gender-linked preferences in members of the socioeconomic groups under consideration here (Biesanz et al., 1988, pp. 90–98; Méndez Barrantes, 1988, pp. 37–38).

All three of San Juan's lab teachers acknowledged there was competition in the lab, even though Costa Rican educators may not value competition as much as their United States' counterparts[6] (see Marín and Marín's, 1991, pp. 11–12 discussion of allocentrism). It is probably for this reason that the lab teachers felt they had to justify this competition by pointing out its beneficial effects. When Maestra Pamela was asked whether there was competition in her lab, she began by saying that competition was indeed a problem. However, she immediately changed her mind and said, "No, it's not a problem. It's normal. For some students competition is beneficial. They're improving themselves. It's not a problem." The other two lab teachers agree with Maestra Pamela that competition in the lab is beneficial. Maestra Victoria added that the level of competition is not very pronounced but suggested that it could account for the fact that students sometimes copy and erase the designs of others. Maestra Andrea indicated that there is competition in some of her groups but not all.

The students are somewhat less willing than their teachers to acknowledge that they or others were competing with each other. Five of the students, two boys and three girls, maintain there is no competition in the lab. Humberto's view is typical of this group. "For me, [programming] is not competitive. I am trying to do my best, but it's not because I'm competing. Rather, [doing my best] is something that I enjoy."

On the other hand, five students assert there is competition in the lab. Four students, two boys and two girls, gave specific examples of boys competing. For example, Juan Carlos, a sixth grade boy, pointed out, "There are students competing. They're making very nice designs, like Johnny. He calls the teacher over to see [them]. Those who are competing are Jorge Alonso, Jimmy, and Esteben. I'm not competing." Only one student gave an example of competition between girls. Laura, a fourth grade girl, remarked, "I'm trying to do my best in the computer lab and in class. Sometimes two of us see who can finish [a project] first. The first one done wins." This kind of competition is somewhat less intense than that reported among boys.

Laura also refers to a behavioral dynamic related to competition, domination of the programming process, that had a negative impact on her enjoyment of lab activities. Her regular computer was down one day and the teacher placed her at another computer with a boy.

> But it wasn't the same. He didn't allow me to do anything. He said, "I'm going to write everything." I wasn't able to do anything. Sometimes I got angry and told the teacher. The teacher told us that we have to share the work between the two of us. My partner said he was sharing, but it was a lie. He made the entire design. Francisco didn't allow me to do anything.

In a number of pairs, one student tends to get control of the keyboard. Maestra Andrea, a lab teacher, thought this was a problem. "Working in pairs is problematic. Very few pairs function [well]. . . . The pairs that function well are those [consisting of students] who are friends outside [the lab]. [When they're not friends], one of the pair always works and the other watches." It is worthwhile noting that Siann et al. (1990, p. 188) report boy LOGO programmers tend to dominate consoles in mixed-sex pairs.

One student dominating the console can clearly affect the level of student enjoyment of LOGO programming. For example, consider these observations of two pairs of fourth grade girls drawing houses:

> [Cindy and Miriam's] roof was only partially drawn and slightly off center. Their neighbors, Milena and Lupita, had also drawn a house. However, its roof was [even more poorly drawn]. Cindy and Miriam commented to Milena and Lupita as they viewed their drawing, "What a roof Milena!" [By doing so, they] acknowledged that Milena is in charge of her and Lupita's project and that their

> roof was poorly drawn. It is worth noting that earlier, Lupita told me that one of the reasons she didn't enjoy using computers was that Milena didn't allow her to use the keyboard.

Both boys and girls were observed trying to gain control of the keyboard. However, this was observed more frequently in male than female pairs. In fact, some girls adopted a more cooperative and collaborative programming style. Consider these observations of two fourth grade girls.

> Maria Fernanda and Ana Patricia [are] drawing [a] Costa Rican flag. . . . Both type in information: Maria Fernanda the numbers and Ana Maria the letters. Maria Fernanda discusses [with Ana Patricia] what they might do. Ana Patricia . . . either accepts or rejects Maria Fernanda's suggestion. Sometimes . . . just the opposite [occurs with Ana Patricia making a suggestion and Maria Fernanda accepting or rejecting it].

In sum, a number of students contended that peer interaction in the lab was somewhat competitive and that students were occasionally excluded from participating. Teachers' comments generally supported this conclusion, although it is clear both from their comments and from observation that neither competition nor practices that exclude girls from participating were constant or extremely strong. Balancing the competition was the fact that students did work in pairs, which girls seemed to do somewhat more comfortably and smoothly than boys.

Teacher and Student Stereotypes of Computer Use

In the United States, Wilder et al. (1985, p. 218) found that both boys and girls from kindergarten through twelfth grade stereotype computers as a male domain. Other researchers have found stereotyping to exist but to be somewhat less robust, concluding that: 1) boys more strongly associate computers with males than do girls; 2) boys stereotype computer use as a male activity, girls do not; or 3) both boys and girls believe computers are for both sexes, though boys feel less strongly about this than girls (Campbell, 1990, p. 492; Chen, 1986, pp. 273–74; Colbourn and Light, 1987, p. 134; DeRemer, 1989, p. 48; Hattie and Fitzgerald, 1987, p. 13; Johnson et al., 1985, p. 673; Kinnear, 1995, p. 32; Levin and Gordon, 1989, p. 79; Shashaani, 1994, p. 438, 1995, p. 32; Smith, 1986, p. 341; Smith, 1987, p. 487; Temple and Lips, 1989, p. 221; see Francis, 1994, p. 287). Studies of LOGO programming that examined stereotyping report Type 2 (Bernhard, 1992, p. 183) and Type 3 results (Siann et al., 1990, p. 188).

This research, which taken as a whole suggests that computing is often seen as a predominantly male activity, has been used to argue that the stereotypical association of computers with males causes girls to like computers less than boys, have less confidence using computers, and experience more anxiety. This contention is supported by research conducted in the United States which suggests that many individuals avoid activities which have traditionally been associated with the other gender, even when this results in passing up the opportunity to gain valued rewards (Bem and Lenney, 1976; Bem, Martyna, and Watson, 1976). Such behavior is not too surprising. Individuals tend to discourage others from engaging in behavior associated with the other sex and to disapprove of others who evidence interests or behavior traditionally associated with those of the other sex (Feinman, 1974, 1981; Martin, 1990).

However, the view that existing stereotypes cause females in the United States or Costa Rica to have less positive attitudes towards computers is but one possibility. It also seems likely that girls' less positive attitudes toward computers leads to their using computers less frequently and less enthusiastically than boys. Students who observe this in the lab then come to stereotype computing as a male activity on the basis of their own experience. It is important to note that even if these stereotypes reflect actual gender differences in computing behavior and attitudes, they also serve to maintain them. Girls come to understand that computer use does not "fit" their gender, which may well make them reluctant to become skilled in computer use, even if their own initial personal attitudes about computers did not inhibit this.

The stereotypical association of computers with males was evident at San Juan in students of both sexes as well as in the lab teachers. Both groups seemed quite willing to generalize about the computer-related interests and capabilities of boys and girls as a group, rather than speaking just in terms of individual preferences and aptitudes. Consider some of the comments made by the three female lab teachers. One lab teacher stated that, "Boys are more interested in computers than girls. It's a very, very, very marked difference. . . . Boys are more creative. . . . Boys are interested in math and social studies; girls in Spanish." Another lab teacher believed boys are more interested in computers "because, in general, boys are more analytical; they reason with more persistence." The third lab teacher agreed with her coworkers. "Boys [are more interested in computers]. They are more creative and scientific."

Since teachers frequently evaluate students and have considerable power over their students' school activities, their stereotypical association of computers with males would be expected to strongly influence lab interactions and student attitudes toward computers. In addition, the division of the lab into male and female sections and differences in male and female dress would tend

to make this gender-linked association salient (see Deaux and Major, 1987, pp. 373–74). Not surprisingly, the students' attitudes mirror their lab teachers' (cf. Hawkins, 1985). The majority of boys think boys, as a group, are better programmers than girls. For example, Javier, a sixth grade boy, reported, "Girls don't like the lab. Girls work very slowly and make simple things. [In contrast], boys pay more attention in the lab. [Even] the teacher says boys are better at computers than girls. Girls are best at family life (hogar), religion, and music; boys are best at computers and physical education." Nestor, a fourth grade boy, had a similar attitude toward girl computer users. "Computers interest boys more because they have more ability. Girls play with dolls like Barbie. Computers aren't for girls."

Many of the girls agree with their male classmates, attributing greater liking or aptitude for computers to boys as a group than to girls. Yorlenny, a fourth grade girl, said, "I like computers, but many girls don't. Computers interest boys more. . . . Boys make boats . . . , many things. I believe boys like computers more." Some of the girls base their opinions upon what they had observed in the lab. Yenori, a sixth grade girl, remarked, "Computers interest boys more because they're the ones who play the most with computers, who go crazy over them."

There are a few exceptions to this general tendency for students to see computing as a male domain. Four of the thirteen students interviewed (two boys and two girls) thought girls are as interested and as capable programmers as boys. However, none of the students thought that computers are more appropriate for girls than boys.

There is also evidence of students stereotyping lab work as a male activity at Escuela Pérez, although such stereotyping is more evident in boys than girls. Boys were much more likely than girls to indicate that learning to work with computers is more important for boys, that computers interest boys more, and that boys make the best projects. In addition, boys are less likely than girls to believe that girls are just as capable as boys using the computer.

The fact that San Juan's teachers explicitly link LOGO programming to math may have reinforced the idea that boys are better at computing than girls. Although it is FOD policy that the students' lab work not be graded, the lab teachers had reservations about this policy and decided to consider the quality of their students' lab work when calculating their math grades. The knowledge that LOGO programming affects a student's grade in mathematics is widespread among students.

Linking LOGO lab work to math seems likely to reinforce the perceived similarity between these two activities. It has been shown that Costa Rican sixth grade boys achieve a higher level of proficiency in math than do their female classmates (Esquivel and Brenes, 1988, p. 4). Although to our knowledge no researcher has examined gender and its relationship to attitudes toward math in Costa Rica, there is a large body of evidence suggesting that females in the United States show less confidence in their math ability and less interest in math than males (Chipman, Brush, and Wilson, 1985; Hyde, Fennema, Ryan, Frost, and Hopp, 1990). If this pattern holds in Costa Rica, as is likely given the preponderance of males among those pursuing technical education and careers in fields which require mathematics, the link between LOGO and math at Escuela San Juan may well have reinforced the gender-linked patterning of attitudes discussed above (see Clarke and Chambers, 1989, pp. 412–13).

Before we leave stereotyping, one important issue must be addressed. In explaining the stereotyping of computing as a male activity in the United States, one factor which is often invoked as a contributing factor is the relative paucity of female role models (Beynon, 1991, p. 288; Chen, 1986, p. 279; Fish, Gross, and Sanders, 1986, p. 184; Hawkins, Sheingold, Gearhart, and Berger, 1982, p. 371; Levin and Gordon, 1989, p. 86; Miura, 1987, p. 305; Schofield, 1995; Temple and Lips, 1989, p. 224). Yet all of the lab teachers at Escuela San Juan were female, as were most of the other teachers who assisted in the lab, and these teachers performed their duties in ways which daily demonstrated clear competence (see Gutiérrez, 1994, pp. 127–28).

The question then arises as to how the presence of these positive role models can be reconciled with the clear stereotyping discussed above. First, it must be pointed out that role models are seen as important in leading to change, but not so overwhelmingly important that supplying them will immediately undo the impact of all the other forces which may still foster the maintenance of stereotypes. Second, since teaching, especially elementary school teaching, is so overwhelmingly a female profession in Costa Rica, it may be that students just expect their teachers to be female. If this is the case, then students would not necessarily conclude that females like using computers because they have female lab teachers.

One fascinating example of the way students think about their lab teachers comes from an interview with a boy who was a skilled computer user himself. When asked if any student knows more about LOGO than his teacher did, he replied, "There are no students who know more than the lab teacher because Maestra Victoria has more experience and took a course. We [students] didn't. In comparison to us she's a 'superman.'"[7] Interestingly, the teacher's prowess on the computer conjured up a prototypically male image of Superman. Furthermore, the teacher's skill was clearly attributed to her training rather than to any particularly outstanding aptitude in this domain.

In addition, certain of the regular classroom teachers' behaviors in the lab conveyed the impression that women were not really interested in computing

or that boys were better at computing than girls. Thus, even though the lab teachers modelled competence personally, the regular classroom teachers may have inadvertently reinforced the impression students gained from other sources that computing is a male domain. For example, instead of working with students in the lab the full eighty minutes, regular classroom teachers sometimes attend administrative meetings, grade homework in the lab, chat with teachers passing by, or go to the teachers' lounge.

At Escuela Pérez, where quantitative data were collected on this topic, regular classroom teachers, who were female, spend only 54 percent of the lab period interacting with students. In contrast, the lab teachers, who were also female, spend 74 percent of their time with students.[8] Clearly, the presence of female teachers in the lab does not assure girls will always see enthusiastic adult female computer users (see Hoyles and Sutherland, 1989, p. 161; Sanders and Stone, 1986, p. 16).

San Juan's lab teachers also tend to encourage boys rather than girls to assist other students when they are busy, thus reinforcing the image of boys as especially skilled in this domain. Johanna, a sixth grade girl, remarks, "Maestra Victoria . . . calls over Jose Carlos when I don't understand something. He explains it to me." Maestra Victoria actually formalized the role of student lab assistant. She selected a sixth grade boy, Carlos Andrés, to help her with students in the lower grades. Carlos Andrés helps out his lab teacher once or twice each week. He does not view himself as a full-fledged lab teacher. Rather, he sees himself as his teacher's "right hand." He says he enjoys his work immensely. "I feel really good around [the students] because I'm always helping those who don't understand. I'm very happy because I'm helping the children to learn." He hopes to teach computing in the future. Although the teachers may single out boys as formal or informal assistants because of their competence and enthusiasm, this pattern nonetheless reinforces the image of computers as associated with males. Lab teachers also sometimes appear to focus more student attention on boys' projects than on girls' projects, thus emphasizing male expertise as discussed in the next section of this paper.

Differential Assistance In LOGO Programming

To our knowledge, Huber and Scaglion (1995) are the only researchers to have examined gender-linked patterns in the level of assistance students are offered by teachers in computer labs. However, Guntermann and Tovar (1987, p. 324) found that boys using LOGO request more assistance from classmates than do girls. It is also worth noting that in the United States, math teachers generally spend more time with males than females, praise boys more, give boys more academic help, and are more likely to accept boys' comments during classroom discussions (Campbell, 1986, p. 517; Fennema, 1980, p. 169; Leinhardt, Seewald, and Engel, 1979, p. 432; Sadker and Sadker, 1985, p. 54). Female mathematics teachers are just as likely as male teachers to give more assistance to boys (Fennema 1980, p. 169).

Allowing segregation of the classroom by sex, a common practice in San Juan's LOGO lab, may well increase the likelihood that teachers will help boys. In classrooms where boys and girls sit in different sections, Sadker and Sadker (1985, p. 56) suggest that after a student answers a question, teachers tend to question students in the same general area. Because boys are often more assertive than girls, the teacher interacts with the boys' section longer. Giving so much assistance to boys communicates to them that mathematics is very important. In addition, of course, it often provides extra instruction directed specifically at their needs.

There is some evidence that San Juan's girls receive less assistance and guidance from their lab teachers, regular classroom teachers, and classmates in the LOGO lab than their male peers. The three lab teachers were asked who they helped the most in the lab. Maestra Andrea said, "I help both [boys and girls] but because boys are more interested, I'm with them more." She also says she tends to spend more time with students in the upper grades and with the most capable students, because they stimulate her the most and show the most interest. The other two lab teachers said that they thought they gave the same level of assistance to boys and girls. However, Maestra Victoria also stated that she spent more time with the most capable students, "because they call me over to see their designs." Since she also believes that boys are the most capable computer users, it is reasonable to infer that she too assisted boys more than girls. Therefore, it is very likely that San Juan's lab teachers actually spend more time with boys in the lab than with girls.

Several of San Juan's students (two boys and two girls) reported boys receive more help from the lab teachers than girls. Yenori's explanation for this is similar to that of Maestra Andrea, her lab teacher. "The teacher helps boys more because they know the most [about LOGO]." Only one student, Juan Carlos, thought the lab teacher helped the girls in his sixth grade computer lab more than boys.

Lab and regular classroom teachers at Escuela Pérez clearly interacted more frequently with boys than girls in the computer lab (Huber and Scaglion, 1995, pp. 15–16). Observations of lab and regular classroom teachers interacting with individual students and student pairs show that lab teachers spend 59.6 percent of their time with boys and 40.4 percent of their time with girls. This difference is meaningful in light of the fact that almost exactly 50 percent of the students from the twenty-nine groups observed in the lab were girls (554 girls and 551 boys). Classroom teachers, who tend to play a more sec-

ondary role in the lab, allocate their time somewhat more equitably in the lab. They interact with boys 53.9 percent and girls 46.1 percent of the time. This disparity does not go unfelt by students. Specifically, the girls were more likely than the boys to indicate on the Computer Attitude Scale that they would like the lab and regular classroom teachers to spend more time with them in the lab.

In order to better appreciate these quantitative differences, consider these observations of a group of kindergartners using LOGO at San Juan. On this particular day, the lab teacher (Maestra Andrea), the students' regular classroom teacher (Grace), and a regional tutor from the Fundación Omar Dengo (also a woman) were present in the lab.

> Grace and the tutor spend most of their time helping the boys. Maestra Andrea spends [a roughly] equal amount of time with boys and girls. At one point [though], all three were helping boys. Three girls got out of their seats and asked Maestra Andrea to help them. "I'm coming now," says Maestra Andrea. . . . [At the end of class], I observe that most of the boys have "nice" well-formed box shapes. Few girls do. I believe this occurred because Grace and the tutor helped the boys with their boxes much more than they did the girls. Maestra Andrea confirmed my analysis but added that the girls' figures were more creative and free, and corresponded more closely to their real capabilities.

With respect to students assisting other students, both sexes report receiving more help from boys, at least under certain circumstances. When students were asked what they did when they had a problem and both teachers were busy, nine students volunteered names of student helpers. Seven of these students, four girls and three boys, reported receiving assistance from boys. Yorlenny, a fourth grade girl, gave this reason for calling over a boy. "Yes, a classmate helps me when both teachers are busy. [When both are busy] then I say to him, 'Alan, how is this done?' Since he has a computer a home, he tells me." Only two students, both girls, named girls who give them assistance.

Extra-Curricular Computer Experience

Yorlenny's comment just above suggests another factor which may contribute to the attitudinal differences under discussion in this paper. Consistent with findings in the United States (Brady and Slesnick, 1985; Chen, 1986; Hess and Miura, 1985; Sanders, 1984), boys at Escuela San Juan were more likely than girls to report that their parents actively encourage them to develop their computing skills in various ways. Humberto, a sixth grade boy, said, "My parents encourage me. When I tell them I want to know a bit more [about computing], they help me to find teachers from whom I can learn more and by buying me diskettes." Laura, a fourth grader, was the only girl to report that her parents actively encourage her to learn more about computers. It is interesting to note how she responded to their advice.

> I've told my parents I'm in computing. My mother thinks that's very good and my father says I may be able to take computer courses [outside of school]. I've told them that's good. . . . They encourage me. They always say, "Laura, why don't you take computer classes?" But I don't know, because I'm in the school chorus. To be in both at the same time would be difficult.

There is considerable evidence that, like boys elsewhere (Busch, 1995, p. 151; Chambers and Clarke, 1987, p. 513; Chen, 1986, p. 271; Hattie and Fitzgerald, 1987, p. 10; Levin and Gordon, 1989, p. 791; Loyd et al., 1987, p. 18; Sanders and Stone, 1986, p. 4; Siann et al., 1990, p. 186; Wilder et al., 1985, p. 223; Woodrow, 1994, p. 329), boys who were interviewed at San Juan use computers outside of school more frequently than do girls. This extracurricular experience helps to foster their skills and puts their female classmates at a relative disadvantage. For example, boys were more likely than girls to report using a computer at a relative's or friend's house. Nestor's out-of-class use undoubtedly contributed to his acknowledged expertise in school. "The first time I used a computer was two and one-half years ago at my cousins' house. I made designs with LOGO." Carlos Andrés, the sixth grade boy who served as Maestra Victoria's lab assistant, was the only student to have reported taking a computer course outside of school. Note his level of confidence. "I was in a computing course in the fourth grade. After two months, I was programming. It turned out well. I was a very capable boy. I liked computers from the very first." Humberto, a sixth grade boy, was the only student interviewed who reported having a computer at home. "The first time I used a computer was at a computer exposition. My father purchased one and we have it at home. I started using it about a year ago whenever the teacher assigned written work."

Though there are a few exceptions (e.g., Krendl et al., 1989, p. 91), most investigators have concluded that the more computer-related experience students have, the more positive their attitudes toward computers become (Badagliacco, 1990, p. 48; Campbell, 1988, p. 115; Chambers and Clarke, 1987, p. 503; Chen, 1986, p. 278; Colley et al., 1994, pp. 133–34; DeRemer, 1989, p. 48; Dyck and Smither, 1994, p. 243; Igbaria and Chakrabarti, 1990, p. 233; Koohang, 1989, p. 148; Levin and Gordon, 1989, p. 84; Loyd and Gressard, 1984, p. 73; Loyd et al., 1987, pp. 17–18; Miura, 1987, pp. 308–10; Robertson et al., 1995, p. 77; Robinson-Staveley and Cooper, 1990, p. 174; Sacks, Bellisimo, and Mergendoller, 1993–94, p. 266; Smith, 1986, p. 343; Wilder et al., 1985, pp. 221–23; Woodrow, 1994, pp. 318, 330). However, we

agree with Chambers and Clarke (1987, p. 498), Chen (1986, p. 279), and Levin and Gordon (1989, p. 85) that scholars need to be critical of broad generalizations about the positive impact of computer experience. Specifically, the social dynamics of extra-curricular computer experiences, the meaning students attach to them, and their impact on attitudes can be somewhat different from the dynamics, meaning, and impact of in-school computer experiences. For example, computer use outside of school is likely to be voluntary rather than compulsory. In addition, with the exception of enrolling in a computer course, students using computers outside of school probably work individually or in very small groups rather than in groups of thirty to forty students.

Many extracurricular computer experiences, especially using a computer at home or at a friend's or relative's house, would be expected to have a positive impact on attitudes (see Campbell, 1988, p. 113; Levin and Gordon, 1989, p. 79). Both sexes would tend to become more skillful, confident, and favorably disposed toward computers with experience. In contrast, it is at least possible that the more time students use computers in milieus which support and maintain the traditional linkage between gender and computer use, the wider the gap will become between boys' and girls' attitudes. To the extent that work in a computer lab is competitive, that boys exclude girls from programming, that students and teachers explicitly associate computers with boys, and that boys receive more assistance from teachers and classmates, boys are likely to develop more positive attitudes than girls over time.

The findings of two studies are consistent with the last point. Chambers and Clarke (1987, p. 503) found that after using computers at school for a year, the attitudes of elementary and secondary school girls were significantly less positive than the boys', although boys' and girls' attitudes did not differ initially. Collis (1985, p. 34) examined the impact of a school computer literacy course on the attitudes of eighth and twelfth graders. Compared to their respective same-sex control groups, boys had more positive attitudes after completing the course, while girls had less favorable ones.

Discussion of the Findings and Concluding Remarks

Theory and findings based upon work in educational settings in the United States and elsewhere were clearly supported by the research undertaken in Costa Rica. In general, San Juan's students have favorable attitudes toward computer-related activities and become quite skilled in using LOGO. However, girls report liking lab work less than boys and are less confident of their programming ability. They were also less likely to use the computer lab outside of regularly scheduled lab periods, at least partly because of their anxieties about the lab environment. Thus, the situation at Escuela San Juan was remarkably similar to that reported in earlier studies in the United States and elsewhere.

Qualitative research at Escuela San Juan, with its emphasis on "thick description," has allowed us to flesh out and interpret findings from earlier studies. For example, San Juan's students overwhelmingly reported liking working in the computer lab, as have students in many previous studies. However, the reasons students gave for this often had very little to do with the LOGOWRITER software *per se*. They enjoyed the absence of tests and having the freedom to talk more and write less. Similarly, girls at San Juan (and Pérez) were found to be somewhat more anxious than boys. However, girls tended to be anxious not about computer use *per se* but about interpersonal difficulties with peers and lab teachers. A recently published qualitative study of computer use in a high school in the United States suggests yet another factor creating positive attitudes toward computers: changes in the teacher's role that led to more individualized instruction and less lecturing (Schofield, 1995).

Most quantitative research has not examined in great detail the computer cultures that develop after educational computing programs are implemented. Computer cultures such as San Juan's are extremely complex. The elements of these cultures "work as a web of mutually supporting, interacting processes" (Papert, 1987, p. 26). Recall that Javier reported that he believed LOGO was best suited for boys because his teacher told him so and because he observed the complex designs some boys create with the assistance of their teachers and peers. Nestor's confidence in his ability to program was a major reason he liked LOGO. The fact that he had two and one half year's experience using LOGO prior to programming in school contributed to his high level of confidence. Girls such as Lupita got discouraged about programming because they did not like being excluded from participating in lab work.

Some aspects of San Juan's computer culture appear to have a greater impact on student attitudes than others. The stereotypical association of LOGO, and computers more generally, with boys appears to be particularly important. As a consequence of this stereotype, teachers, parents, and students behave toward boys in ways which encourage them to do things like enrolling in computer courses outside of school, using a computer at home, and spending time in the LOGO lab during recess. These experiences build the boys' confidence and ability to program well. Because boys are confident and experienced computer users, teachers and girls turn to boys for assistance. Since girls have relatively few girlfriends who are expert programmers or who encourage them to value computing, they conclude that boys are best suited

for programming. This is something girls have observed first-hand and have been told by others. The belief that boys are most suited for programming becomes a self-fulfilling prophecy.

The view that all parts of San Juan's computer culture are interrelated has implications for educators who wish to encourage girls to view computers more favorably. We suggest that educators implement strategies that involve all relevant groups: students, teachers, parents, and administrators (see Sanders and Stone, 1988). Strategies that focus on one group to the exclusion of others address only part of the problem. San Juan's LOGO lab had three well-trained and dedicated women teachers. Their presence as positive role models would be expected to encourage girls to view LOGO positively. However, their teachers' positive example was offset by several mitigating circumstances. The lab teachers believed and occasionally even stated to students that LOGO programming was more appropriate for boys than girls. In addition, they spent more time assisting boys and encouraged boys to formally or informally serve as lab assistants.

Gender differences in attitudes and behavior in San Juan's LOGO lab should be viewed in their broadest possible context. As was indicated at the beginning of this paper, many roles and relationships between the sexes in Costa Rica are defined by the machismo-marianismo complex. Males are expected to acquire the requisite scientific knowledge and technical skills that prepare them for authoritative positions in business, government, and education. Similar sorts of roles, skills, and knowledge are thought to be less appropriate for females. These gender-linked differences are depicted in and reinforced by school textbooks, television and radio programs, magazines, and socialization practices. In a very real sense, San Juan's computer lab is a microcosm of Costa Rican society.

Research was undertaken less than a year after San Juan's lab became operational. Since the lab was observed during its initial phase of operation, it makes sense to view lab interactions and student attitudes toward computers as having been strongly influenced by more general aspects of Costa Rica's culture. However, it also seems likely that computer labs like San Juan's will play a role in helping to reproduce Costa Rica's gender status quo in the future (see Apple, 1986, pp. 170–71; Krendl et al., 1989, p. 85). When fully implemented, Costa Rica's computerization program will reach one-third of this country's public school children. Children whose attitudes towards computers will be based upon six year's experience will soon be graduating from schools. If the attitudes of San Juan's students are an indication of things to come, we would expect more boys than girls to gravitate toward educational programs in which knowledge of and training in computer applications are important: computer science, engineering, economics, business, the natural sciences, and educational administration. These are exactly the sorts of programs that will allow young Costa Rican men to attain influential positions in government, private enterprise, and universities. Since gender-linked aspects of San Juan's computer culture are remarkably similar to those documented in research in the United States and elsewhere, this prediction may very well apply to many other societies around the world.