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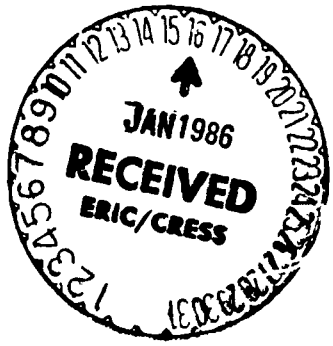
ABSTRACT

A participant observation study was conducted to address socialization, cultural, and values questions related to high school students' interactions with microcomputers. Specific issues addressed included: (1) student social patterns in microcomputer interactions; (2) cultural and sex differences in microcomputer interactions; and (3) student affective responses to microcomputers. Observational study occurred in beginning programming classes and free computer lab periods (before and after school and during lunch) for a period of one semester; student interviews were also used to collect data. Results substantiate previously reported gender differences in enrollment in advanced classes and use of the microcomputer lab outside class time, with the males predominating in those areas. Although female enrollment equaled that of the males in the introductory level of programming classes, they did exhibit less interest in computer classes, computer use, and computer careers than the males. In addition, the males in gender-mixed groups tended to dominate the keyboard for both typing and input of data. There was a great deal of interaction, primarily academic in nature, related to microcomputers: student-to-student, student-to-teacher, and student-to-microcomputer. Generally, the interaction was open in the classes, but in the noon lab, student-to-student interaction was more evident between/among the "regulars." It is noted that the computer itself is an interactive medium, and that the class structure and student preference for working in pairs/groups further stimulated interactive behavior. A list of references is provided. (JB)

A LOOK AT HIGH SCHOOL STUDENTS AND COMPUTERS
AN OBSERVATIONAL STUDY



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SECTION ONE

Introduction and Methodology

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INTRODUCTION TO THE QUALITATIVE STUDY

During my undergraduate years (as a sociology major) and my graduate years (as an education major) I had developed and maintained an interest in qualitative studies. While in my doctoral program that interest resulted in a suggestion by my advisory committee that I take a course in the methods of qualitative research. Being an agreeable (and interested) student, I found myself enrolled the next semester in such a course. The major requirement for the course was that a participant observation study be conducted and reported.

Because one of my primary areas of focus in the field of educational technology involved the utilization of computers in education, I chose that general area for study. Further refining the general topic, I decided to concentrate my observations at the high school level with emphasis on the interactions of students with microcomputers. From previous readings of qualitative and quantitative research in this area and from some of my own interests, I formulated some initial questions to address in the study.

Many studies have pointed out the gender differences in educational use of the microcomputer. One of the studies was by Miura and Hess; they concluded in their study of enrollment differences in computer camps and summer classes "that training outside of course offerings during the school year is sought more often by males..." and that "disparity between boys and girls increases with age, is greater in

advanced than in beginning programs, and is larger for expensive programs." (Miura and Hess, 1984, p. 22). A study cited by Lockheeed and Fralt showed that of "400 students enrolled in a required introductory computer science course almost half the boys, but virtually no girls, used the computer center outside of the required class time" and that "by male self-selection and female default, the computer center becomes defined as 'male turf'--a socially inappropriate to girls as the boys' locker room." (Lockheed and Fralt, 1984, p. 126) Sanders says that research "studies document the existence of the sex discrepancy in computer use." (Sanders, 1984, p. 32) A study which concentrated on possible differences in aptitudes and interests was conducted by Horn; the results, reported in PSYCHOLOGY TODAY, indicated that there were no significant differences between males and females on the basis of aptitudes, only on the basis of interests with the females being less interested that the males.(PSYCHOLOGY TOLAY, 1985) Thus gender differences--with male control and participation as general themes--were documented by the literature as existing in society thus suggesting that as an area of study. Data from the National Assessment of Science for 1982 indicated that "young women in secondary schools are less likely than young men to spend time with computers and to enroll in computer classes." (Anderson, Welch, and Harris, 1984, p. 12)

A theme related to gender differences was differences in minority involvement with computers. Miura and Hess

also reported that the enrollment in summer computer camps was "overwhelmingly Caucasian"--about 91 per cent. (Miura and Hess, 1984, p. 22)

Another possible theme to observe was that of interaction occurring in computer classes, both social interaction and student to microcomputer interaction. Schneiderman says that research studies indicated that "social interaction supports intellectual work. The social interaction among peers in programming can be a wonderful opportunity to understand problems, formulate solutions, ask for and give assistance and show off results. Several studies have shown that two students per terminal leads to faster learning and superior satisfaction." (Schneiderman, 1984, p. 16) In a study of primary school children Jewson and Pea observed that the "children seem to collaborate and teach each other more when they are working with microcomputers than they do in other classroom work." (Jewson and Pea, 1984, p. 332) A particular type of social interaction was described as that of an interaction between the instructor and a "student expert" who being very knowledgable about computers acted as a helper to the instructor; the student assumed a new role in the educational environment. (Sheingold, Kane, and Enderwelt, 1983, p. 418).

Interaction between the student and the microcomputer itself has been another area of research. One study by Ryba and Chapman dealt with "on task" behaviors. They observed "that slow-learning students spent 91% of their total time

actively engaged in attending and problem solving." (Ryba and Chapman, p. 126, 1984) Interaction with the microcomputer at the level of personalization of the computer by the user has also been suggested in the literature. Turkle says that some children can identify with the computer and that "...the computer, reactive and interactive, offers companionship without the threat of human intimacy." (Turkle, 1984, p. 135) In the book COMPUTER POWER AND HUMAN REASON, Weizenbaum described reactions to the program ELIZA, a program which simulated the "responses of a nondirective psychotherapist in an initial psychiatric interview." He stated that "ELIZA created the most remarkable illusion of having understood in the minds of the many people who conversed with it. People who knew very well that they were conversing with a machine soon forgot that fact, just as theatergoers, in the grip of suspended disbelief, soon forget that the action they are witnessing is not 'real.' This illusion was especially strong and most tenaciously clung to among people who knew little or nothing about computers. They would often demand to be permitted to converse with the system in private, and would, after conversing with it for a time, insist, in spite of my explanations, that the machine really understood them." (Weizenbaum, 1976, pp. 188-189) The individual student to computer interaction and social interactions occurring around computers formed other questions to pursue.

Initially the questions centered around the gender and interaction themes. The list of questions included the following:

SOCIALIZATION:

1. Do students interact singly or in pairs/groups when interacting with microcomputers?
2. Do the students assume identifiable roles when interacting with microcomputers? If so, how can those roles be described?
3. Do students personalize microcomputers or treat microcomputers as machines?
4. Are there "rules" that students observe in their interaction with microcomputers?
5. Do some students interact more frequently with microcomputers than others? If so, which students do so?

CULTURAL:

1. Do male and female interaction patterns differ? If so, how do they differ?
2. Do minorities/majority interaction patterns
3. differ? If so, how do they differ?
3. Do different cultural subgroups assume different roles in their interaction with microcomputers?
4. Do any cultural differences seem to be more important factors in interaction patterns? If so, what are those factors?

VALUES:

1. Why do students interact with microcomputers?
2. How important is the interaction to the students? Why is it or why is it not important?
3. How do the students describe the interaction? What is their affective response to microcomputers?
4. Are meanings related to academics or to other factors (such as the fun in working with microcomputers)?

From this base of questions, I began the study finding answers or partial answers to some of the questions, no clear answers to others, and answers that I was not even seeking. The data that I collected included information related to gender differences, the existence of a microcomputer subculture, and general interaction patterns of students in microcomputer environments.

Sections relating the methodology, the descriptions and interpretations of the data, the conclusions, and limitations follow.

DESCRIPTION OF THE METHODOLOGY

After the initial problem and guiding questions were selected, a site was chosen based primarily on three criteria. The criteria included:

1. The size of the school and community--large and urban;
2. The existence of microcomputer classes in the high school curriculum; and
3. The accessibility of those classes to the researcher for the observations.

The high school chosen (and hereafter referred to as Computerville High School) met all three criteria. It was a school with approximately 1300 junior and senior students. Located in a community of approximately 90,000 citizens that was a part of an urban complex in the central United States, the high school population was composed primarily of middle and upper-middle class students with a small representation of minority students (a problem which resulted in no answers to questions regarding minority students). The campus itself was located near the downtown area on a main thoroughfare in the community.

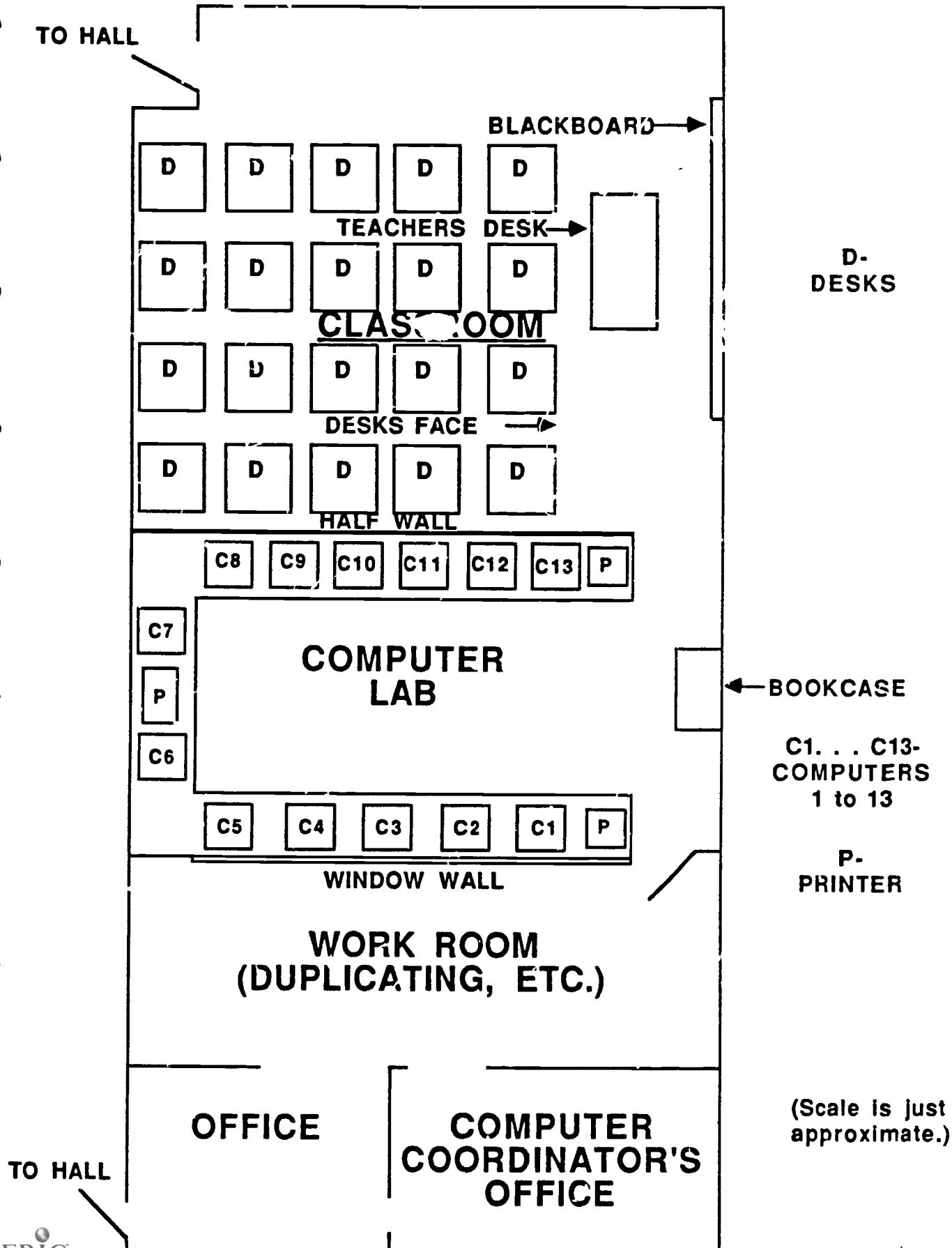
Computerville High School's curriculum included the computer programming classes as well as computer usage classes (such as word processing and accounting applications courses); the observational study focused on the beginning programming classes. At the time of the study the computer usage classes were operated through the business

education department, and the programming classes were directed by the computer coordinator with teachers certified in mathematics teaching the programming classes. Two male instructors and one female instructor taught the beginning and advanced programming courses. During the semester of observation, three beginning and two advanced courses were offered in the programming area with the BASIC computer language taught in the introductory courses and the PASCAL language taught in the advanced courses. One prerequisite was required for students to enroll in the beginning courses; it was Algebra I. Previous enrollment or proficiency in programming was required for enrollment in the advanced classes. All the programming courses were held in the combination microcomputer classroom/lab (see Diagram 1, page 10) with Apple microcomputers serving as the particular brand of microcomputers used for instruction. There were thirteen Apple microcomputers and two printers in the lab area of the room which was located in the main building on the high school campus. The microcomputer room was next to the computer coordinator's office and a staff work area; it was separated from the office area by a glass window wall. In the lab area were posted the rules:

1. No food or drinks;
2. NO games;
3. No copy programs except COPYA; and
4. ABSOLUTELY do not open the computers.

Initial application for approval of the research was

Diagram I


TO HALL
BLACKBOARD
D
TEACHERS DESK
CLASSROOM
DESKS FACE
HALF WALL
C8
C9
C10
C11
C12
C13
P
C7
P
C6
COMPUTER LAB
BOOKCASE
C5
C4
C3
C2
C1
P
WINDOW WALL
WORK ROOM (DUPLICATING, ETC.)
OFFICE
COMPUTER COORDINATOR'S OFFICE
TO HALL
D- DESKS
C1. . . C13- COMPUTERS 1 to 13
P- PRINTER
(Scale is just approximate.)

labs. A tape recorder was utilized in taping student interviews near the end of the semester.

The following sections report the data collected and the interpretations of the data in relation to previously cited research findings and other major themes observed and identified.

SECTION TWO--DATA ANALYSIS

High School Microcomputer Subculture
Gender Differences
Interactions

MICROCOMPUTER HIGH SCHOOL SUBCULTURE

The unanticipated and interesting find of the study was the existence of a high school subculture inhabiting the microcomputer lab primarily during the noon lab period. As I began and continued to observe the noon lab periods I began to identify some "microcomputer regulars"--students who were in the lab every time or almost everytime that I was observing. There were approximately eight to twelve "regulars", eight of whom I could identify as being very regular in their use of the lab. After observing this group I started to look for confirmation that others too had observed this particular group. If the existence of the particular group was further verified by others, I planned to look for characteristics peculiar to this group.

The computer coordinator, the teacher whose classes that I observed, a staff member, and the students using the noon lab all confirmed that indeed there was a regular group who visited the noon lab. The computer coordinator also said that during previous years when the lab was open there had been a variety of groups with regular users of the microcomputers. So from my observations and the observations of others I felt that I could say that there was a group of "microcomputer regulars"--but in what sense was it a cohesive group?

How many students made up the group? As I mentioned, I had observed eight identifiable "microcomputer regulars" and about four others who might fit into that group. The

students that I interviewed described the number of regular users as being "six, seven including me", "five of us always hanging around together...like add another five more", "seven or eight", "eight to twenty", and "ten--five who hang around outside school and at school." During the seven labs that I observed the group did vary from about eight to twelve students who were familiar to me so the group number was approximately in that range judging from my observations and from student responses.

Besides being regular users of the noon microcomputer lab, what else characterized this group? Through my observations and information from interviews, I began to see the emergence of some patterns.

The most evident and common pattern that emerged was the interest in microcomputers and the computer area as a whole. The students came into the lab primarily to use the microcomputers; even if a particular student was not using a microcomputer when in the lab, the student would be watching and interacting with those who were working at the Apple microcomputers. The presence of that current interest extended also to future career plans for those students, the "microcomputer regulars". Career plans included computer careers as well as careers which would heavily involve use of computers, such as engineering. One of the students said that his career plans included "natural sciences or physics, maybe computers." Some of the students were even working with computers in part-time jobs during that semester. One of the

"microcomputer regulars" had a job in a neighboring city at a computer store; two students were working on building their own computer; and three of them mentioned that they did consulting work for people, performing such jobs as the tranlation of a software program written in one computer language to another computer language--charging fees for such services. The interest was a serious one with the group of "microcomputer regulars" holding future plans for their computer skills.

The "regulars" were generally more advanced users of microcomputers. The students did both advanced programming and applications usage of the microcomputers. One of the "regulars" worked in machine language (a language much more difficult to program than BASIC), and another student had programmed his own shape tables. Some of the "regulars" were enrolled in the advanced PASCAL class. One of the students did not seem to be such an advanced user but was always in the noon lab using software, particularly games. Although he did not appear to be so proficient in advanced skills, he seemed comfortable with and interested in microcomputers, expressing a desire to own a personal computer apart from the family computer.

Another central theme related to the interest in computers was that the "microcomputer regulars" tended to own computer hardware (the equipment itself) and software (the disk packages that give instructions to the hardware, such as a game software package). The instructor of the classes that

I observed said that the "microcomputer regulars" had a lot of money in software and that they weren't necessarily good programmers but had "a lot of equipment." One day while observing in the noon lab, I informally asked the students in the lab if they had microcomputers or access to microcomputers at home. All the "microcomputer regulars" who were in the lab that day said they either ha a microcomputer/computer or had access to one at their homes. There were also five other students in the lab who were not regular users; of those, four did not have microcomputers/computers at home, but one's father had an IBM at his office and one said that she did have access to a computer. One of the other students did have an Atari microcomputer at home. Of those "microcomputer regulars" responding, three mentioned that they had Commodore microcomputers at home, one responded that he had a Radio Shack model, one was "babysitting" a microcomputer for a friend who was out of the country, and four mentioned that they had Apple microcomputers at home. One of the "microcomputer regulars" also had access to a digital computer, a larger, more complex computer than the microcomputers mentioned. One of the regular students also responded that his family owned the microcomputer but he had all the software. Another said that he was the only family member who knew how to use the microcomputer though it was a family computer. So another trend was home ownership of microcomputers and software for the observed group of regular student users.

Another offshoot of the computer interest was that some

of the terminology used in general conversation by the "microcomputer regulars" included terms from the technical language of computing. On one occasion, a "microcomputer regular" recommended to another to use "random commands" to improve his graphics program. Technical terms overheard from another conversation included "running out of memory," "breadboard," and "chips." One question asked of another "microcomputer regular" was, "Where is the location of BASIC memory for...?" in reference to shape tables. "Call -151," "Save program, then FP," "BLOAD it now," "put shape table at 8000 and set high memory at 36268," "HPLOT," "don't know how to use flags," "Hit CONTROL S twice to cut the sound," "string function," "Copy A would do it," "don't initialize mine," 'input/output error," "what's that POKE?," "is that HGR or GR?" were other technical comments heard during the noon lab observations when the "microcomputer regulars" were talking. The conversations that I heard were certainly not all technical with other typical high school comments like "Awesome!", "you're very funny," "that's good," and "holy cow" appearing in the conversations, but it was sufficiently technical in nature to likely exclude students not knowledgeable in the terminology from participating in some of the conversation. (Had I not possessed some knowledge of programming and computers myself, I would likely had problems hearing and copying the technical terms correctly.) I did ask one of the "regulars" if he thought that people without computer

made through a formal written application form addressed to the board of education; a research approval committee reviewed the application and allowed the study to be conducted based upon restrictions and specifications of the high school administration. My contact was one of the vice-principals who, in working with the computer coordinator, arranged for me to observe two of the BASIC programming classes which were taught by one of the male instructors. I was also allowed to observe free lab periods--before school, during lunch, and after school. All observations were conducted during the Spring semester, 1985, beginning in February and concluding in May.

From a beginning date of February 22nd I observed 15 class periods(8 in the morning section and 7 in the afternoon section), 7 lunch free lab periods, and 5 brief before-school free lab periods. Observations of the students were combined with interviews of both the personnel and students to provide additional data. Class periods consisted of 50 minute sessions. The lunchtime free lab was a 60 minute session and most of the before school observations were from 10 to 15 minutes in length. Interviews ranged from ones that were brief and unstructured to more lengthy, structured formats--all were based on the availability and schedules of the interviewees, with none during class time. The interviewees included the computer coordinator, the coordinator of counseling, the programming instructor, two members of the staff, and students in the classes and the noontime free

knowledge could follow some of their conversations. He seemed surprised to be asked that as if he had never thought of that possibility; he replied "No", that they could not follow. This group's interest led them to talk partially in a technical language that was in the area of computing; it was a shared language for the "microcomputer regulars" much like the language of career and ethnic groups.

FIGURE II

Excerpt

J: How did you get into computers?

I started using them in school.

About what grade level, about eighth?

Yeh, eighth grade is when they prescribe it.

And you took a class?

No. I just moped around on them.

In the lab? Did they have a lab set up?

J: Were you in that same junior high that some of the other guys were in?

Yes.

OK. So you all were a group even then almost?

Yeh.

Another common theme within the group of "microcomputer regulars" was that of gender. There were no female regulars. There were females who occasionally used the Apples in the noon lab, but not on a regular basis nor they socially interact with the "regulars." I observed females in the lab on six occasions, but they were always outnumbered by the males in the noon lab. This observation was consistent with the research reported by Lockheed and Frakt that virtually no girls used the lab outside regular class times. (Lockheed and Frakt, 1984) I quizzed some of the "microcomputer regulars" about female participation in the noon lab and received such answers as:

> "What girls--they rarely come in--once in a while to work on lessons",
>
> "Males (come in)--I don't know why",
>
> "More male students", and
>
> "Sometimes girls come into the lab to do their accounting problems."

The instructor of the introductory BASIC classes said that sometimes girlfriends would come in with their boyfriends, but the boyfriends used the microcomputers.

In addition to being less evident in the noon lab, the females were also likely to not interact with the "regulars". Any verbal communication was quite brief in manner; they might greet some of the "microcomputer regulars" as they entered or ask for assistance regarding their work with the microcomputer. During one lab period two girls who were

working on their accounting problems for a class asked one of the "regulars" how to turn on a printer, but nothing else. In another of my observations, one female asked a question of me rather than of any of the "regulars." In addition to the social verbal distancing, the females also distanced themselves physically, generally sitting toward the east end of the lab and not next to any of the "regulars" who sat toward the west end of the lab (one of the "regulars" sat at the west end because the color monitor was at that end, and he was often working on color graphics he had designed).

The females not only used the lab infrequently but also worked on a narrower range of microcomputer usages than did the males when they were controlling the keyboard (on two occasions females accompanied males into the lab but did not work at the Apples). I asked the females and males what they were working on during three of the noon lab sessions. The females were working on programming class homework, accounting problems, and on a project for a science class--all the work was related to class assignments. The males were using the microcomputers for word processing, games, homework assignments from their programming classes, graphics, software programs they had programmed for their own uses, and some commercial software programs such as one that printed a variety of font styles on paper.

The lab did appear to be "male territory" such as the "male turf" described by Lockheed and Frakt. (Lockheed and Frakt, 1984) Also the females' interests did not seem to

lead them toward computers and thus toward the noon lab as did the "microcomputer regulars."

Trying to identify certain personality traits common to the group of "microcomputer regulars" was not too fruitful an undertaking; the interest in computing seemed to be the most pervasive personality trait. When interviewing the computer coordinator, I asked about distinctive characteristics of the group; he said that the personalities changed from year to year and that the "regulars" varied from students who received failing notices to straight-A students. He believed that the group included both serious and not-so-serious students; some were "hackers". He also said that some of the students had interests in other technical areas such as one student who had worked with the stage equipment for high school drama productions. The coordinator thought that--at least in the previous years--the "regulars" ran around together; he termed the "microcomputer regulars" as "freaks."

The programming instructor said that the "regulars," whom he called "gamers," had a lot of equipment, were not necessarily good students (he had learned this when checking grade point averages to see which students might be eligible to attend a computer contest), were lacking in social maturity (he thought they probably spent too much time in the lab), that some already had jobs in the computer field, and that the members of the subculture were always together.

I asked three females how they would describe the "regulars" in the noon lab (two of the females did use the noon lab for programming assignments). The two females who had used the lab called the "microcomputer regulars" "smart" or "brains," and the other female called them "whizzes." Their descriptive terminology differed from that of the computer coordinator and the instructor so I sought out further clarification in interviews with the "regulars" themselves.

One of the "regulars" labeled the others (and himself) as "all pretty odd--eccentric or unique" but also said that most of the students' grade point averages were pretty good though personally his was not good. Another "regular" said that the others would work on inventive programs in the attempt to out-impress each other. A quote from another "regular" was, "Everybody's got their own personality, their own reason to be in here; most of them aren't that athletic; they're more or less into things like computers, learning mathematics, or something." He also said that most of the grade point averages were good with the exception of himself and one other person and that most of the "regulars" were introverts. Other interests mentioned in the interviews included cars, bombs, karate, and going to movies. When asked what term might best describe them, they chose the term "hacker;" one student explained that "most of them, 50% at least, hack"--meaning try to break programs.

From the information I gathered it appeared that the

group members varied on many points--grade point averages, interests other than computers, and their personalities in general. This type of variation in a related group was also described by Turkle who said the "hacker" culture was a "culture of mastery, individualism, and nonsensuality." (Turkle, 1984, p. 223) The Cracker further describes the "hacker" culture as being different from most other groups primarily on the basis of their fascination with learning about computers that don't belong to them. (The Cracker, 1985, p. 62) Because all the "microcomputer regulars" did not hack, they could not fit into that group, but in later years those high school students could leave the high school group later moving in to the "hacker" culture. I felt that labeling the "regulars" by the term "gamer" was not totally appropriate because not all were devoted to the use of games while in the microcomputer lab; the term "brains" was not appropriate since not all the students were "A" students. "Freak" was only mentioned once as a label for those students. The only term that I felt comfortable with was "microcomputer regular" (or "regular").

I had identified a gender differentiation, the use of a somewhat technical language, home ownership of computers, a career interest in computers, and a variety of personality variables in the group. They were regular users of the lab, but there seemed to be other defining characteristics of the group.

What else bound the "microcomputer regulars" into this grouping beside their interest in computing and their gender? Their personalities seemed to vary, much like those who were in the hacker culture. What bound five or six of those 'regulars" together was their friendship with each other; the other regulars were in interaction with them primarily during the noon lab period. One of the "regulars" in the friendship group said that "...five of us are always hanging around together" and another responded "five" to my question of how many of the lab "regulars" he hung around with both in and out of school. One other said that about four people would run around together and that he ran around with five of the people in the lab. This group of five also paired off occasionally; I observed them sometimes entering and leaving the lab in pairs or groups of three. One of the students not in the small friendship group had observed that two or three of the "regulars" were often together. Both the computer coordinator and the instructor of the observed classes made comments that the "microcomputer regulars" spent much of their time together.

Those "regulars" not in the smaller friendship grouping did interact with each other as well as with the smaller group. Two of the "outside regulars" identified themselves as being "a loner" and "an introvert," with one of them saying there might be "a half-dozen loners" in the lab on a regular basis. These two students were the students who tended to spend their whole lunch period in the microcomputer

lab while the other "regulars" would drift in after lunch. (One did say that he was on a diet so he didn't eat lunch.) One of the "loners" had known most of the good friends while in junior high school. They had also used the microcomputer lab in junior high school. He would often be in the lab which was locked controlling the entrance by asking for a software program before he would let anyone enter. Another one of the "regulars" said that most of his friends were from outside the school--partially because he didn't live near any of the other "regulars."

So within the group of "microcomputer regulars" there were approximately five to six good friends, a couple of self-identified loners, and one who had other friends from outside the group. But within the group of "microcomputer regulars", all the students found acceptance of each other and interacted with each other within the environment of the lab. There appeared to be some common elements among the "regulars"--computer interest, regular use of the lab (a use which had begun early in the school year), having an advanced programming class together (PASCAL, in this case), and advanced knowledge of programming. Just how these variables interacted differed for students, but early entry into the group seemed to be a key point. Two male students who had computer interests began using the lab during the spring semester. One of those males was only in the introductory BASIC class; when he was in the lab he usually physically separated himself from the "regulars" and would not interact

with them; he seemed to hold an interest in computers but was not working at an advanced level nor was he one of the early users of the lab. The other male seemed to possess an advanced knowledge of computers, but he told me that he had just started using the lab--about midway through the spring semester. He even brought his own friends into the lab with him. One time he was accompanied by a male and a female and on another occasion he was accompanied by the male who had come before; neither friend ever worked at the microcomputer but just sat watching him. This young man had been in a programming class the previous year. He did not interact with any of the regulars during the lab sessions that I observed. He did interact with his friends and with one female at another microcomputer. He started going to the lab late in the year, was not as regular in his use, and was not enrolled in a computer programming class--but he did indeed have an interest in the computer. The male in the beginning programming class was a fairly regular user of the lab, but had just started during the second semester; he was not enrolled in an advanced class. Most of the "microcomputer regulars" possessed all the common traits or at least possessed an interest in computers and early, regular use of the lab. There was one student who was not a regular user and was not enrolled in a class, but seemed to interact with the "regulars" when he came in. He appeared to be a friend of one of the icrocomputer regulars" so that may have permitted and "olayed" his entry into the group.

The group members seemed to be accepting of the other group members and just ignored the "extras" who sometimes came to the lab during noon. However, a couple of conversations that I noted (one which I overheard and one in which I was involved by informally asking questions) suggested that the "microcomputer regulars"--like all subculture members--had formulated some norms about who might be accepted by their group. In one case the conversation (in which I was involved) centered around the uses of the microcomputer particularly for word processing. I had asked if they used word processing for most of their written work. A couple of the "regulars" responded that they didn't use word processing for class assignments because some of the teachers at the high school would not allow the use of the word processing software. They also said that the teachers didn't even know what word processing was. I sensed a disgruntlement with the teachers' lack of knowledge about computers; that feeling may also extend to others not knowledgeable about computers thus excluding those from group membership.*

*I sometimes felt that the "regulars" talked with me because I was in an advanced educational program and because I had some knowledge of computers. Thus the "regulars" defined my role as being someone who was "okay"; they could talk with me and answer my questions in a fairly open manner.

Another conversation (that I partially overheard) included the comment "car won't carry Blacks" and a response "Did I hear prejudice?" suggesting another norm for acceptance--not being Black. There were no Black "microcomputer regulars". However, there were at least three Black students in the two classes that I observed in this high school with a low minority enrollment. One of the "regulars" was a recognizably different background from outside the United States but was quite accepted so it may have been that the acceptance was quite specific in acceptance or rejection of certain minority groups.

Broom and Selznick define a subculture as being "...a pattern that is in significant respects distinctive but that has important continuities with a host or dominant culture." (Broom and Selznick, 1976, p. 75) This group of "microcomputer regulars" was just another group of high school students but distinctive with respect to interests, gender, and the use of a technical language--and probably with respect to patterns of group acceptance. Because not all the "regulars" were "hackers", they could not be included within that culture; however, the similarity in the interest in computing was common to both groups. Perhaps this is another subculture to add to the list of high school (and perhaps even to lower levels of school--such as junior high) subcultures.

I had identified computer interest (defined by career interests, home use of computers, enrollment in computer classes--primarily advanced classes), regularity of use of

the microcomputers in the lab during free lab times, and early entry into the lab during the school year as some of the observed defining characteristics of the group. There seemed to be a possibility to extend those definitions or include other characteristics with more study.

GENDER DIFFERENCES

The existence of gender differences in computer education has been documented by other research (such as those listed in the Introduction) indicating that the males outnumber females in the class enrollments, summer camp enrollment, home computer use, and interest in computers. Turkle points out another gender difference--that most of the "soft" mastery programmers are female and most "hard" mastery programmers are male. She defines a "soft" mastery programmer as a person who uses "the imposition of will over the machine through the implementation of a plan--with the program as a premeditated control" and a "soft" mastery programmer as "more interactive--the mastery of the artist." "Experiences everywhere reinforce the assumption that computers are a male domain: computer arcades are dark, noisy places that attract boys and men; high school computer science courses reflect high male enrollment figures; parents fill after-school computer classes and computer camps with their sons, not their daughters." (Gilliland, p. 42, 1984) A study by Jacquelyn Eccles reported that women "shut themselves off from scientific and technical fields." (THE SUNDAY OKLAHOMAN, p. 6) In the observations at Computerville High School, the data collected further substantiated the existence of a gender gap in the area of computer programming, with some slight variation from the previously reported differences.

In the introductory BASIC classes, which were composed

of juniors and seniors, the enrollment was about equal even though it was at the high school level; even one of the two introductory BASIC teachers was female. The gap did indeed appear at the advanced level of programming classes with very few females enrolled in the advanced PASCAL classes. When queried, the instructor that was observed said that the females and males in the introductory BASIC classes did not differ in grades for the course; he even thought that the females in general were more serious in their work habits by concentrating on the lessons and seeking extra-credit work than were the males who tended to be more interested in their own projects--such as graphics of a car that was one male student's interest--than in the class work or in extra-credit work. The instructor also observed that probably one of the best, if not the best, student in the advanced PASCAL class was a female. So the enrollment gap at advanced levels was substantiated at Computerville High School, but there was no reported difference in abilities (consistent with Horn's research study that was previously reported).

The gap in use of microcomputers outside class time was also substantiated by observations at the high school. The free lab periods during lunch and before school were rarely visited by females, although some females did use the microcomputer lab during their off-hours which occurred during regular class hours (this was reported by the instructor observed). When females did enter the lab, they used the microcomputers exclusively for class work or projects while

the males used the microcomputers for a variety of purposes--school work, games, individual programming projects, word processing (although females in the business education department may have used the business microcomputer lab for those purposes--this was outside my observations), and as a "hangout"--probably best said when one of the lab regulars said that the other lab regulars "looked more comfortable in the microcomputer lab than anywhere else." After a few observations of the free lab times, I asked the instructor about female use of the lab. He said that occasionally a girlfriend might accompany her boyfriend into the lab but the boyfriend would be the microcomputer user (I did observe this particular situation occur twice during my observations) and that occasionally a few females might do some work in the lab, but it was predominantly a male group in the lab. This discrepancy of male/female usage of free lab periods occurred throughout the observation period, thus substantiating the Lockheed and Fralt study. (Lockheed and Fralt, 1984)

Observing the differences in classes and in use of the microcomputer lab, I sought answers concerning why females did not enroll in advanced classes or did not often use the lab. When asking both female and male students about possible differences, the most frequent response was that females were not as interested in computers as were the male students--although one of the regular lab users qualified his answer with the statement that adult females were often just as interested in computers as were the males; it was

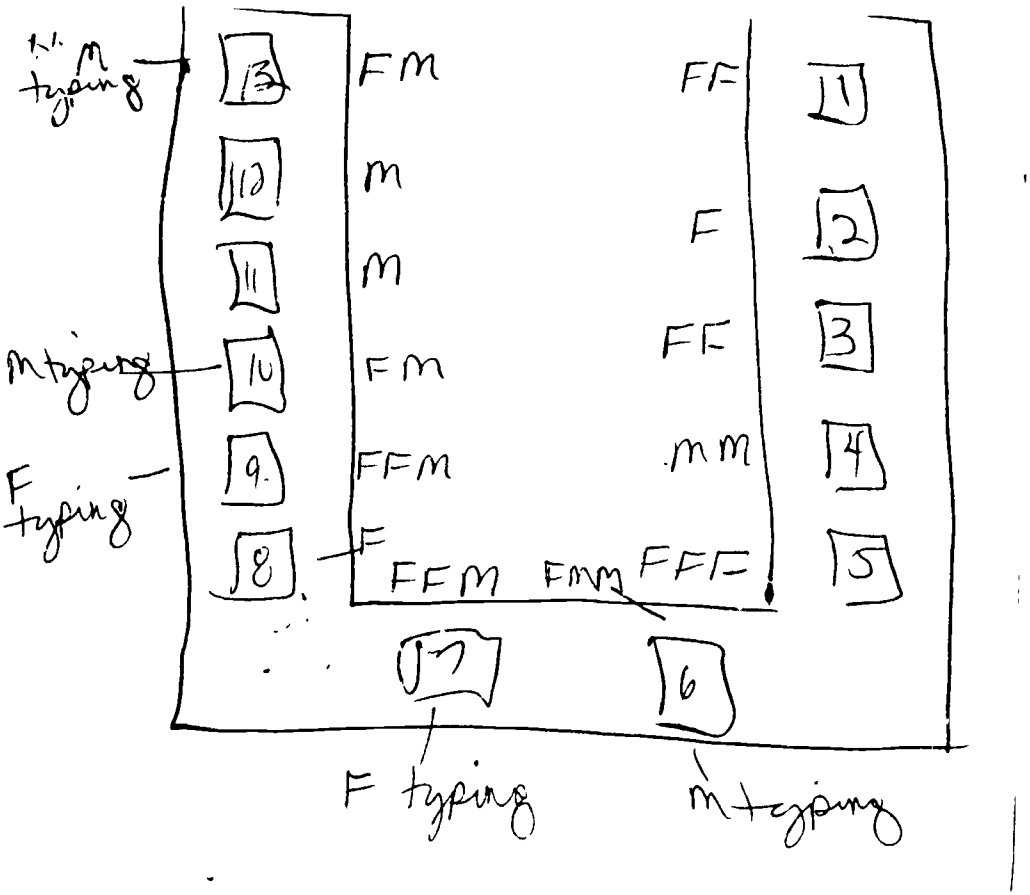
just at the younger ages that there was a difference (his mother was teaching a computer programming class at the college level thus suggesting an influence on his thoughts about female interest). When asked about the reasons for the difference, the instructor whose classes were observed said that the females--when prompted to enroll in the advanced classes--would say that the class was too hard or that the class would ruin their grade point average, but he did not believe that the females were stating their true feelings. A few of the lab regulars said that some of the females may have felt that the advanced class was too difficult, but that the feeling was also common to some males who had enrolled in the advanced classes but who had dropped out within the first week or two of the semester. The computer coordinator noted that the primary difference in females and males was that he had never known of a female "hacker." An interview with the coordinator of the counseling services further substantiated the lack of interest on the part of the females--and also introduced another possible reason for the disparity, that of a lack of self-confidence. When asked why female students did not enroll in the advanced classes or dropped out once enrolled, she gave the example of two female students--one who dropped out and one who stayed in the class. She described the female who dropped out as being fearful of the class and the female who continued as hesitant at first and as needing reassurance--which was provided by the counselor (and by the instructor of the introductory

BASIC class). According to the counselor, the girl was "self-assured" and had a good math background. She also said that once the girl enrolled and was in the class for a period of a few weeks, the girl had come in to see the counselor to report her good progress in PASCAL. The counselor thought that in general females in the advanced programming classes were "self-assured and had good grade point averages." She felt that with many of the girls there was the lack of understanding about the importance of computers in society, a feeling of insecurity and perhaps a feeling that computers involved a lot of mathematics. She made some further related comments saying that very few females asked about computer careers, such as programming; most just asked about careers which could involve some use of computers. Even the female student who was doing well in PASCAL was interested in a medical career--not solely a computer career. She had also observed that when males came into the counseling center to utilize the GIS, the males would not remain hesitant at the terminal keyboard as long as the females (GIS is the Guidance Information System, which is a computerized data bank for career information; the student receives information through a terminal at the high school which is hooked up through a phone modem to a main-frame computer in another city). She thought that a lack of typing skills might interfere with some of the males' use of the GIS, but still females were less confident in their approach to the computer terminal. She also noted that more junior high students--during the

pre-enrollment sessions--were interested in enrolling in the computer programming classes as compared to previous years, but she was not sure if the males outnumbered the females or not. She did say that most of the students interested in computers also had math and science career interests.

FIGURE III

Diagram of a Seating Pattern in the Lab



One gender difference that I was not looking for from my previous readings but that I did observe was in the actual physical control of the microcomputer. Though the difference was not pronounced, the males tended to take control of the microcomputer keyboards. In gender mixed pairs or groups of three, the males tended to control the typing/ input functions at the microcomputer keyboard when the class moved to the lab area to do homework assignments. I observed approximately 44 occasions in which there were mixed pairs or groups of three at the microcomputer in the classroom periods; on those occasions only seven of the pairs/groups shared the typing responsibilities. Sixteen females typed during the period; and twenty-one males typed. The differences observed were more pronounced at the initial stages of observation but as the semester progressed, the females began to control the keyboard more often. Whether more of the females had typing skills than the males in those classes (it was a possibility since females still far outnumbered males in Computerville High School's typing classes--but possibly not the particular females in the introductory computer programming classes observed), the males still tended to dominate. During one class period I overheard a conversation between a male and a female in a mixed group of two males and one female. The female said, "I haven't typed in weeks." The males responded (in a polite manner), "Do you want to type?" I overheard no more of the conversation, but the female did not take over the typing duties during that class period. A possible

explanation for the difference in control may be the lack of self-confidence on the part of the females alluded to by the coordinator of counseling; the males may have felt more comfortable with the microcomputer thus being more relaxed in controlling the keyboard. The change in dominance patterns toward the end of the semester (with more females dominating) may have been the result of the females gaining more assurance toward the microcomputer through their classroom activities.

Another possible theme, perhaps related to the issue of control/dominance, was that males tended to use the microcomputers alone more often than the females during classroom periods. In observed classroom periods, the males tended to outnumber the females in individual usage by about two to one, with approximately fourteen males to seven females using the microcomputers alone when microcomputers were available. Perhaps the males preferred working alone while the females preferred socializing or perhaps the males felt more comfortable and self-assured with the microcomputers than did the females. The issue was not clear, thus indicating a need for further study in this area.

The "soft masters" and "hard masters" as defined by Turkle did not appear in this observational study. Such intense study of styles was not possible during the classroom periods observed; the regular lab users seemed to tend toward the "hard mastery" styles, but the observation was not sufficient to identify those styles.

The observations and the data from interviews further indicated that there were gender differences--those gender differences related to interests (both present and future), enrollment in advanced classes, and in control and use of the microcomputer and the microcomputer lab. Another possible difference suggested was that of self-confidence, perhaps self-confidence in relation to the microcomputer or self-confidence in general.

INTERACTIONS

In the classroom setting, it was difficult--if not virtually impossible--to observe individual students' interaction and possible personalization of computers. However, observing the individuals during the free lab periods provided more opportunities to look for possible acts of personalization and the types of interaction patterns that might emerge, such as the "hard masters" and "soft masters" described by Turkle. (Turkle, 1984)

At this age level there was not much personalization of the microcomputers evident. The students did not name the microcomputers nor often use personal pronouns in talking about the microcomputers. I did observe a couple of times when a student was interacting with the Apple as with a person. During one of the noon lab periods, one of the "regulars" said "Shut up" to the microcomputer when some sound effects were bothering him. When the sound stopped, the "regular" said "thank you." However, most of the conversations about the microcomputers that I heard were not at at a personal level. Students used the pronoun "it" rather than personal pronouns saying such phrases as "It beat me" and "What did you do--you killed it." Other comments included "...how this thing (referring to the microcomputer) works" and "You mean the machine talks!" and "The machine talks. Did you hear it?" During one lab one of the "regulars" was referring to a figure in a karate game as "he," but it was not a direct reference to the computer only to

the character in the game. It may be that more personalization was occurring but I could not hear it; what I did hear was generally not a representation of personalization. However, it may be possible that the "regulars" in the free lab periods may have been indirectly personalizing the microcomputer by choosing to spend time with the Apple rather than with other students.

The interaction that was most evident to the researcher in the class periods--and also in the free lab periods--was the total group and small group interaction. There was a great deal of social interaction over a variety of social combinations. As the instructor whose class was observed said, the computer programming class had built-in interaction through the presence of multiple users at the microcomputers. With only thirteen microcomputers available and over twenty students in each of the classes, the students had to work together at the microcomputers. Regarding total group interaction in the classes, most of it centered around conventional manners. I observed students politely checking to see if certain microcomputers or printers were available before they sat down to use them. The students generally waited patiently for the instructor to finish giving another group assistance rather than interrupting him. Group interaction in the free lab period was generally limited to the lab "regulars" who would sometimes gather together to watch a particular program. During the noon lab the "microcomputer regulars" gathered around two of the Apples to watch a game

that was a simulation of nuclear war; they were commenting about the graphics in the game and changing the size of the bomb strike areas.

Because the programming classes had to be separated into pairs, groups of three, and individual units to work on the number of microcomputers available, interaction was also evident in and between those variations. Students in the classes very seldom worked individually on the microcomputers even when there were microcomputers available. The students seemed to prefer working in pairs or groups of three. The instructor said, when asked about this behavior, that very rarely did any individual students ask to work alone at a microcomputer; he remembered only one student asking to work alone during that semester. Occasionally he would have to rearrange or break up the pairs/groups because of discipline problems. The interaction within these small groups centered around the microcomputer work, but students also participated in social conversations discussing non-school topics such as a student's family or weekend plans. Between the small groups the interaction too centered primarily on the microcomputer work. For example, one student pair might ask another pair for help with debugging (correcting a mistake in a computer program) or they might share a good programming step in one of their programs. Although much of the interaction was based on proximity--those closest were interaction partners--some students would even leave their seats at their microcomputer

to go to another pair to ask for help or to watch a program execution. There was also some conversation about non-computer subjects, such as where to buy tickets for the prom. However, the "time-on-task" was good and the conversations generally focused on the work.

Much interaction occurred between the students and the instructor--generally dealing with assistance in debugging. When the students were at the microcomputers, they would ask the teacher for help. He would go to the group and help them in the small group situations. He observed that students were more likely to ask questions in the microcomputer lab because the interaction was more private than in full-group classes, such as the geometry class he taught. He also observed that he found himself answering the same questions many times because not only were the questions more private but the answers were too. I did not observe any particular "student experts" interacting with the instructor. But two of the "microcomputer regulars" had programmed a grade book management program for one of the high school instructors suggesting that there may be "student experts" in relation to other instructors at the high school

In the free lab periods, there was also interaction but restricted primarily to the "regulars." The interaction also concerned computers primarily, but social conversation also took place. Because there was no instructor in the lab, the students tended to ask each other for assistance when needed, but they sometimes would go to the computer coordinator's

office, which was on the other side of a glass window wall of the microcomputer lab, and seek help from one of the teachers (if any were there--they usually were during lunch). The students who were not "microcomputer regulars" would occasionally interact with each other, but generally paid more attention to their work with the microcomputers.

In general, it could be observed that there was constant interaction--interaction between students and microcomputers, interaction between students, and interaction between the instructor and students--in a variety of patterns. There were few observable patterns within that interaction other than the fact that the students interacted most within their small groups or with other small groups near them. Most students in the programming classes would interact with the instructor when assistance was needed, but they also asked help from the other students. To observe for "hard masters" and "soft masters" was not possible with this study, but it appeared that most of the "regulars" would fit the hard mastery label more than that of soft mastery. (Turkle, 1984) The structure of teaching in a lab class led to more social interaction than would be found in more traditional classrooms where there is a predominance of student-teacher interaction patterns and little student-student interaction. There was no mention of the interaction improving student's grades or social abilities; more research, perhaps of a quantitative nature, could have yielded more information about the results of the interaction.

SECTION THREE

Conclusions and Limitations

CONCLUSIONS

From the collected and analyzed data, themes emerged regarding gender differences, the existence of a subculture which seemed to evolve from computer interest, and interaction patterns and characteristics.

Observations in this study of Computerville High School further substantiated previously reported gender differences in respect to enrollment in advanced classes and use of the microcomputer lab outside class time with the males predominating in those areas. A slight difference from previously reported research was observed in the enrollment at the introductory level of programming classes--even with the math prerequisite of Algebra I; female enrollment equaled that of the males. Also there was no instructor reported difference in grades between the males and females in the introductory BASIC classes observed. This equality may be attributed to the type of high school (middle to upper-middle class in a professionally oriented community) or to the fact that there was no other introductory course, such as computer literacy available to the high school students (a computer literacy class was planned for the next school year at Computerville). It may also have been an outgrowth of the fact that these high school students were introduced to the microcomputers at earlier ages, particularly at the junior high level, thus taking away some of the mystique of the microcomputer and providing more familiarity with the machine itself. Another previously cited difference was the gender difference in

interests. (PSYCHOLOGY TODAY, 1985). The males were reported to hold more interest in computers; the findings of this study, primarily from interviews of students and of staff at Computerville High School, also indicated that females held less interest for computer classes, computer use, and computer careers than the males. An additional gender difference observed that was not reported in the literature related to the control of the microcomputer itself (I am not claiming an exhaustive review; there may be a report addressing this issue). Two minor themes emerged under the heading of control; they were gender differences in preference of working alone or with others and in the control of the keyboard. In gender mixed pairs and groups of three, the males tended to dominate the keyboard for both typing and input of data. The pattern of keyboard control seemed to be moving toward a pattern of equality at the end of the semester thus suggesting that the increasing female familiarity with the microcomputers may have boosted self-assurance and thus the desire to control the keyboards. This possible self-assurance was suggested in an interview with the coordinator of counseling. She felt that females who were more self-assured enrolled in the advanced courses of programming. Possibly self-assurance and interest played important roles in determining which females undertake computer programming, particularly at advanced levels or as career interests. Further study, with test measurements of self-assurance, may provide substantiation of this assertion.

The males tended to prefer working alone at the microcomputers when there were microcomputers available for single users in class periods.

The addition of a new subculture to the list of high school subcultures was another theme suggested by the data in the study. That the group existed and that it did not really fit the categorization of the hacker subculture as defined by Turkle or by The Cracker were themes identified by the researcher. (Turkle, 1984) (The Cracker, 1985) Whether the subculture exists in other high schools or at other levels of the public school or that the group reappeared at Computerville High School in the following years were concerns to consider in adding validity to this particular study. Too, study of the identified themes that characterized the subculture were needed to further substantiate the researcher's findings. The male membership of the group was suggested in previous studies and also in identification of the Hacker subculture. (The Cracker, 1985) (Lockheed and Fraht, 1984) High computer interest (defined by career plans, ownership of personal computers, use of computer terminology in conversation, and enrollment in computer classes--particularly advanced classes), regularity of use of the microcomputer lab, and early entry to use of the lab during the school year were identified as possible defining characteristics of the subculture.

Concerning interaction it was observed that there was much interaction, primarily academic in nature, related to

microcomputers. There was student(s) to student(s) interaction, student to teacher interaction, and student to microcomputer interaction. Generally the interaction was open in the classes, but in the noon lab student(s) to student(s) interaction was more evident between/among the "regulars." The computer itself is an interactive medium; the class structure and the student preference for working in pairs/groups further stimulated interaction.

Findings were consistent with much of the research reported though this study listed some additional possibilities for further research. Any of the findings were probably specific to the particular school environment studied--an urban high school with middle to upper-middle class students who were primarily Caucausian. Findings were also likely to have been specific in respect to the particular classes observed--introductory BASIC programming courses with a math prerequisite of Algebra I. All observations are tentative with more research needed to validate or to further interpret the themes.

The microcomputer has been no exception to modern technological developments which have brought change to our society. The societal impact of computers/microcomputers has pervaded much of our society, including the area of education. Educators have hoped that this piece of modern technology will improve learning, but have sometimes overlooked or underestimated the social forces created by the machine. Because those social factors can interact with

learning, I labeled them as important to study. I attempted to identify, verify, describe, and interpret some of those social forces related to students and microcomputers.

LIMITATIONS OF THE STUDY

Like all research, whether it be qualitative or quantitative, in actual field environments, this particular study was subject to limitations. The limitations were related to both the researcher and the specific population studied thus making generalization to other studies somewhat limited.

On the part of the researcher, the greatest limitation was the inexperience in the area of observational research. It was the first study conducted by the researcher. Overall organization of the study and of the interviews as well as the process of note-taking were aspects which could be improved in further research. The experience itself, continued learning, and feedback from knowledgeable individuals can help to improve those aspects. Also, utilizing tape recordings and/or video recordings could increase the amount of coverage and information gathered in future studies.

Another limitation was related to the researcher was the lack of time to do a very in-depth study of class periods and of free microcomputer lab periods. The researcher was a full-time student as well as a part-time graduate assistant making some visitations difficult, if not impossible. Allowance for more observations would have to be made for any further in-depth studies.

The limitations related to the actual population observed included the restrictions of observation and the type of population observed. Regarding the high school itself, any generalizations would be restricted to highly

comparable schools--with middle to upper-middle class students, a low enrollment proportion of minority students, and urban nature of the community. (However, some of the themes observed were further substantiations of previous research in different settings.) With the school population it was not possible to observe any possible differences in the minority usage of microcomputers. There were simply not enough minority students enrolled at Computerville High School, and of those enrolled, it was not always observable to the researcher if the student was indeed classified as a minority student (such as some of the Title IV-A students). The limitations related to the observation itself are that any generalizations would be applicable only to computer programming classes (which have a math prerequisite of Algebra I), not computer applications classes, such as Computer Literacy or Business Education courses such as word processing. (Once again, the findings were very similar to other reported findings thus improving the credibility of the study itself.) Another area of initial interest that was difficult to pursue in this study was that of values held toward microcomputers; the depth of the study was too shallow and too short for interpreting values. It was noted by the coordinator of counseling and the programming instructor that students enrolled in the introductory BASIC programming class for a variety of reasons--some because of parental pressure (the parents seemed to value the microcomputers), some because of career interests, and some

because they were often not knowledgeable about what the class involved but wanted to learn about computers. Only interests--not values--were identified for the students.

Further study in the same school, Computerville High School, and in other high schools could provide more information--perhaps new information or perhaps like information which could provide further validation. Also, a study designed to focus in-depth for a longer period of time could possibly lead to more detailed interpretation.

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