A CASE STUDY OF MICROCOMPUTERS IN ART EDUCATION

written by

Robert L. Blomeyer, Jr., Ph.D.

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Introduction

   The concept for this formative study evolved as a result of conversations and correspondence between Professor Ivor F. Goodson and the author. The CAL intervention project now referred to as "Curriculum and Context in the Use of Computers for Classroom Learning" being conducted by the Research Unit for Computers and Curriculum Studies (RUCCUS) at the University of Western Ontario in London, Ontario. There, Professor Goodson and his staff were to initiate a major study examining the use of Computer Aided Learning (CAL) in schools located in the vicinity of London, Ontario. The study was funded by the Ontario Ministry of Education as a part of their ongoing efforts to evaluate the impact of CAL on curriculum in the Ontario school boards.

   During the 1980's the Ontario Ministry of Education developed a consistent educational philosophy and generalized policy statement to guide the acquisition and implementation of new instructional technologies in the Ontario school boards (Nielsen, 1989). During that same period the Ministry sponsored the development of the ICON 1 and ICON 2 microcomputer systems. Their approach to materials development and curricular integration has encouraged creative and experienced classroom teachers from Ontario school boards to become software designers and developers.

   The result of Ontario's efforts to develop appropriate instructional technology systems and policies to guide their implementation is the evolution of a microcomputer hardware and software system that is unique to the educational philosophy and curricular content of the Ontario schools. The Ministry's purpose in commissioning the study "Computers in Context in the Use of Computers for Classroom Learning" was:

>   ... to assess and examine the use of computers in classroom learning at the secondary level; to further assess how computer practice might be adapted to maximize learning opportunities; and to provide a series of case studies of how innovative activities in the school can be initiated, implemented, and sustained. (RUCCUS, 1989, p. ii)

   During an initial visit to London, Ontario as a consultant in the Fall of 1988, we discussed the feasibility of a "condensed fieldwork" case study to be conducted soon after implementation of the CAL intervention in the selected school or schools. We also discussed the possibility of creating two field sites so that contrasts and comparisons could be made between particular logistic and administrative protocols that would probably evolve in the cooperating schools.

   The author agreed to and subsequently wrote a paper on methodology which outlined my ideas about using qualitative methods to document initial implementation of new

instructional technologies. That paper (Blomeyer, 1989a) provided the concept that was negotiated into a field study during subsequent interactions with Professor Goodson. I lobbied for an ethnographically-oriented descriptive study to be initiated at the outset of initial classroom use of the new ICON microcomputers.   Because of the scope and scale of the intervention it seemed obvious that the project would be difficult to study initially as a whole. I proposed to conduct a formative *case study* of one curricular area within the total project to make an initial inquiry more manageable.

   This choice of timing was based on the author's assumption that the effects of CAL on classroom learning are strongly context dependent and that the technological, cultural, and political contexts of implementation efforts may be the most significant influences driving the success or failure of technological innovations. My background as an arts and humanities teacher and training in the evaluation of art education programs made selection of the art education curriculum area a logical choice.

   My prior experience working with computer graphics applications in instructional settings suggested to me that the art teachers would probably be among the first to discover hardware and software problems that might lurk behind any CAL system. Graphics applications are generally memory intensive and often interact in unpredictable ways with operating systems, file servers, and other system software. My hunch was later supported by observations of classroom events, but that's getting a bit ahead of the story.
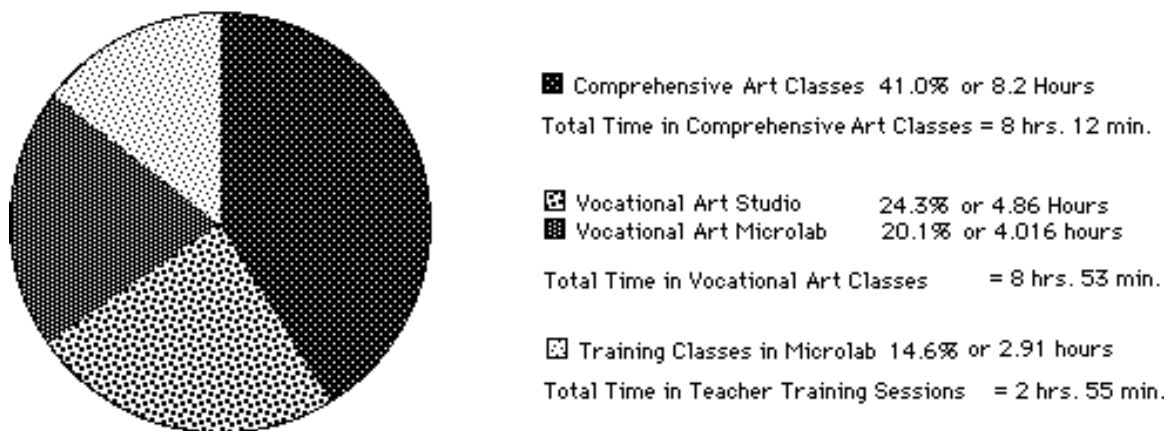
   The formative study was agreed upon in concept by November of 1988 and a tentative date for April was set in January of 1989. Arrangements were finalized with Professor Goodson by March, 1989. We agreed that the field study would be conducted in two schools located in London, Ontario between April 10 and April 22, 1989. One school was to be a comprehensive high school with studio-based art classes taught in a traditional manner and the other school was a vocational high school having a highly specialized graphic arts curriculum. The comprehensive high school was configured with four distributive networked ICON microcomputers in each cooperating classrooms and one printer per classroom. The vocational high school was configured with a centrally located ICON laboratory installation having 25 networked workstations and two shared printers.

   During the two weeks that I was resident in London, the art classes in both schools were observed over a nine day period for a total of seventeen hours and five minutes. I also observed two board of education ICON teacher training classes for a total time of two hours and fifty five minutes. During nine days of observational fieldwork, the fine arts classes in the comprehensive high school were observed for a total of eight hours and twelve minutes and the vocational art classes for a total of eight hours and fifty three minutes.

   In the fine arts classes, there was only one 40 minute class where the ICONs were not being used by the students present. Otherwise, students from all the traditional art classes were systematically rotated on and off of the computers at intervals that coincided with assignment of new studio projects.[1] In the commercial art classes, four hours and fifty two minutes were spent observing in a studio (where only one Macintosh and a laser

printer were a part of the regularly shared art equipment) and four hours and one minute were spent observing the graphic arts students working in the centralized ICON laboratory (See figure 1).

Figure 1
Observational Time in Field Sites

■ Comprehensive Art Classes 41.0% or 8.2 Hours
Total Time in Comprehensive Art Classes = 8 hrs. 12 min.

▣ Vocational Art Studio   24.3% or 4.86 Hours
▩ Vocational Art Microlab   20.1% or 4.016 hours

Total Time in Vocational Art Classes   = 8 hrs. 53 min.

▨ Training Classes in Microlab 14.6% or 2.91 hours
Total Time in Teacher Training Sessions   = 2 hrs. 55 min.

During the first five days of the study, the researcher's verbal interactions with the students and teachers were limited to avoid unnecessary intrusion on the classroom settings. On the sixth day of the field study, interviews were begun with the teachers and with a self-selected sampling of their students. All interviews were tape recorded and tape recordings were taken in the classroom settings when ambient noise levels were low and classroom activities offered suitable subject matter (i.e. a class critique or initial group-mode instruction on a technique).

Foreshadowed Problems

One of the conventions usually followed in planning and conducting naturalistic studies is formalization of a tentative research agenda framed as a list of "foreshadowed problems", questions, or issues like those deliberated by Malinowski in the Argonauts of the Western Pacific (1922). As shown by Lou Smith and Paul Pohland in their seminal study "Education, Technology, and the Rural Highlands", problems and issues evolve from observational fieldwork as events in the real world play themselves out (1974, p. 40). This new case study will attempt to tell the story (Stake, 1988) of computer aided learning in two teachers' art classes within contrasting secondary school settings. In telling the story, the problems and issues that become evident from examination of the new findings should contribute to a clearer focus on the details relevant to understanding the curricular integration of computer aided learning.

The story told here has potential for understanding the value of CAL as an alternative delivery system or tool for instruction. There is particular significance for understanding the pedagogical and curricular implications of microcomputers used as an alternative medium for expressive activities conducted in art classes. Methodological questions are

significant as well. Much about this study is common to the growing body of naturalistic research on CAL (Blomeyer, 1989b). Perhaps a broader role for the RUCCUS project will be integrating new case studies of CAL into a comparative or ethnological perspective on computer aided learning. But, like many of the issues and problems relevant to this project, that is being re-negotiated within the context of a changing technological and institutional framework.

Questions on CAL

The questions that I brought into the study of CAL in secondary art education were in themselves a third generation of questions that I have been working with since 1983-1984. In my research on CAL in secondary foreign language classes (Blomeyer, 1985) I borrowed heavily from a set of questions addressed by the Congressional Office of Technology Assessment in their report 1982 entitled Informational Technology and Its Impact On American Education. (see Blomeyer, 1985, p. 4) In response to the OTA's questions and the particulars of my inquiry about the use of micro-computers in foreign language teaching, I proposed to address seven issues that were obviously relevant to looking at CAL in foreign language instruction. They were:

1. What were the similarities and differences of successful implementation strategies?

2. How do the teachers integrate instructional computing into the foreign language curriculum?

3. What are the optimal levels of functional computer literacy for foreign language teachers?

4. What are the state, district, and individual school policies that are affecting the classroom use of computer assisted language teaching?

5. What are instructional and administrative practices with possible long-range influences on commitment to instructional computing?

6. What is the impact of instructional computing on the "dominant core" of teaching practices?

7. What are the effects of instructional computer use on the equity, efficiency and quality of an instructional program?

Conclusions from my dissertation, further study on the mechanics of curricular integration (Blomeyer, 1986), new research on microcomputer use in elementary curriculum (Blomeyer & Bright, 1987), and four years of work with K-12 teachers from all area specializations and discipline bases have provided new perspectives on my old questions. Most recently, my review and synthesis of the growing corpus of naturalistic studies on CAL (Blomeyer, 1989b) provided the resources for reorganizing a list of questions or issues to guide new research to monitor the implementation of new interactive technologies:

A. The design characteristics of instructional technology applications (with particular attention to the interactive characteristics of CAL),

B. Curricular and disciplinary sources of lesson materials,

C. Pedagogical characteristics attributable to the content domain or the training of teachers as content specialists,

D. Hardware and site implementation (logistic and technical considerations),

E. Availability or access to necessary hardware (e.g., workstations, etc.),

F. The effects of specialized technology training on the abilities of students and teachers to use new technology applications.

(Adapted from Blomeyer, 1989a)

To summarize the changes in my research questions, I have narrowed general questions from earlier research to new issues and questions having answers that may be answerable in quantitatively verifiable ways. Questions A. thru D. above can be addressed by careful content analysis of interactive materials and by carefully documenting and analyzing logistic and instructional activities in particular school sites. Student and teacher activity accounting, construction of both oral and institutional histories of site development, and personal histories of key participants are all strategies that may be used to create an accurate and verifiable account of CAL or other interactive technologies' impact on instructional settings.

The case study presented here on initial use of ICON microcomputers and graphics software in art curriculum uses this modified typology as an initial focus to orient data gathering. Data from this new case study on CAL will contribute to the evolution of new, contextually grounded categories for describing computer aided learning. New categories will then be used to report findings and interpret events. So begins a new iterative cycle of heuristic enquiry and interpretation.

Two School Contexts

ICONs in a Comprehensive High School
(Field Notes: 4-10-89)

Marshall and I pulled into the Brock student parking lot at about the same time as Valerie. Both cars drove far back into the lot before we found free space. Although it was April, there were still small patches of ice and snow on the steps and I hurried in because I didn't have a proper coat for the Canadian "spring". The building was brick construction, had two floors, and looked typical of suburban high schools where classrooms with exterior windows are constructed on both sides of locker-lined hallway. As we walked down the hall I was struck by two things.

First, the environment in the halls was clean, light and cheery. The students were smiling and talking; getting their books out of the lockers and carrying on typical friendly patter.   They were cute, well scrubbed, and looked like cutouts from an Archie comic book. Was I in a time warp? This is like I remember from when I was in high school! Where were the skinheads and punks? Why wasn't I hearing obscenity and where were the security guards? If this school is any example, this experience is liable to be very different from what I've grown used to in suburban and inner-city America.

As we walked down the hall, I looked into the classrooms. The numbers of desks indicated class sizes no larger than the low-mid twenties. The science rooms were well equipped, there were racks and shelves of books, charts, and supplementary materials in every classroom, and although the warning bell had not yet rung, teachers and students were already in the classrooms beginning discussions as preliminaries to the day's business. The polite behavior of the students was outstanding! Virtually every student we passed in the hall smiled and bid us a good morning. A real contrast to the boisterous and rude behaviors I'd encountered recently at home.

We stopped in at the art room where Val and Marshall introduced me to Margaret, the cooperating teacher. She was about five feet and ten inches tall, short blond hair, glasses, a broad and infectious smile, and had the vigorous and energetic appearance of someone who works out or competes in sports. We told her we had an appointment to meet the Board Liaison Peder Nielsen in the Media Center in a few minutes. She walked along with us and started a conversation by asking me what I thought about London Ontario so far. I replied that if everything about London is as pleasant as her school, I will like it very much.

Classes were just starting when we reached the second floor and entered the school's library or Media Center. A large part of the available space was taken up by a large group of kids that were engaged in some sort of activity that was apparently a great deal of fun. They were working in small groups on some sort of collaborative writing project. After we walked through the students, toward some ICON terminals in the back of the room, we were approached by a tall slender man sporting a white turtle neck pullover, a neat but curly black hair, a beard and wearing glasses.

Marshall introduced me to Mr. Peder Nielsen, the Board's liaison office for the CAL project. Peder told us that the students were here today because a nurse working for the London board was there to conduct sex education classes. He pointed out a blond and attractive young woman who was right in the center of the student activity. He suggested that before we went any further, we should go down to the school office so that I could have a proper introduction to the principal.

The five of us walked down to the first floor to the main school office. Out in the hall were two well dressed men discussing a subject related to the day's activity. Both men were wearing ties and looked senior enough to be school administrators. One came forward toward us, looked at Peder and said: "Well, this must be our visiting researcher!"

Peder Introduced me to the principal and assistant principal of the school. The principal, who came forward to address me earlier continued: " Welcome to London

Ontario and Brock High School.   I gather that you've had a look around with Peder and Margarete. What do you think?"

   I stopped for a minute to consider my response... and then said: "Your school is beautiful and open, your students are polite, and your faculty is charming. In fact, would you consider letting me ship the whole operation back to Texas with me? If we can't work that out, can we schedule tours for Houston inner city teachers so that they could see tangible proof that schools like this can still exist?"

   The principal weighed my response for a second, and then broke out into a beatific smile. He took my hand, shook it, and said: "Well! I've heard that things are a bit rougher in the states. So, you really think that we've got things well under control eh?"

   I replied, continuing to shake his hand vigorously: "Why, it reminds me of what high schools were like when I was a student myself in the American mid-west..." I seemed to have made a hit with Margarete's principal. He continued to chat with me for a few minutes about yesterday's unseasonably late snowfall and a bit about the local history of their school.

   After a polite few minutes I excused myself and suggested that we were probably keeping him from his appointed rounds. I knew that Margarete had a second hour class and I wanted to get back to her room so we could discuss our first observation. I also wanted to get a look at the distributive network installation and see how the printers were hooked up in the classroom sites.

   The principal said good-by to Peder and the rest of our party, wished us a good day, and walked into his office.   Peder left us to make an appointment in another school and the rest of us went back downstairs toward the art room. On the way down I asked Margarete how she felt about having so many people as observers in her classroom this morning. She indicated that three observers might be "a bit much". I suggested that Val and I might observe her second hour class and that Val and Marshall might switch for the third hour...

ICONs in a Vocational High School
(Field Notes: 4-12-89)

   I was still without a car this morning so Valerie arranged to pick me up at about 8:10. By about 8:45 we were slowly circling a parking lot across the street from Tecumseh School. As we got out of her car, I looked across the street at Tecumseh. It was a large, grey, three story structure that was partially stone, partially concrete, and partially brick construction. In fact, the different materials roughly matched to different buildings or additions that had evidently been joined together during various expansion or remodeling efforts. The sides of the building were stained by weathering and it had a dingy but massive and solid appearance; like a factory or prison. In short, had great similarity to urban high schools that I was familiar with in the U.S.

   I had already been briefed on Tecumseh's history by Ivor Goodson, the RUCCUS project director. It was a vocational high school with a very long and distinguished

history. It had been founded in 1912 as one of the first fully technical schools in the province. It was at the forefront of educational reforms intended to make the Ontario schools more responsive to the industrial and commercial needs of Ontario's developing industrial economy. It was opened with an initial enrollment of 150 and its growth to the present 2700 students probably corresponds with the types of materials used in constructing various wings of the building.

As we approached the school, we could see groups of students standing around close to the building. They were sheltered from the wind, having a last smoke before going in. As we got closer, we could hear the music from jam boxes that the students had outside with them. The students were not dressed as neatly as those in yesterday's suburban school, but there was a carefully crafted element to their disarray.

Many of the students were wearing trendy faded jeans with patented holes, leather coats, shirt-tails outside oversized wool pullovers with the sleeves rolled back and cuffs stylishly unbuttoned. Many wore expensive sneakers (running shoes) but some of the girls were sporting leather lace-up boots that went part way up ankles covered by argyle socks. In short, these students spent a great deal to get this casual appearance. They seemed to be making a statement about their group identity, or status.

As Val and I came closer and moved toward the doors, the students moved aside to let us through. They were not discourteous, but they were not openly friendly. Their general language usage did not include excesses of obscenity, but there was occasional roughness and vulgarity. They were socially involved with one another to the point that I felt nearly invisible as Val and I threaded out way in through the various group boundaries.

Marshall caught up with us inside. He said that he was going to go immediately to the microcomputer lab. It was located in this older part of the building in a room that had previously been a studio for displaying student art exhibits. When we came to the door, Marshall went in and Val and I went on down the hall to a stairs. The plan called for me to meet Sandi and observe in her 9:00 class. I was to go back down to the ICON lab later and observe a training session that Peder was conducting for a group of the teachers from the Board's "back-up" group. These teachers were trained in case any of the primary project teachers were taken out of their jobs for any unforeseen reason.

Val and I climbed up to the third floor. We went down the hall toward the art room, but it was still locked. No Sandi. Val stopped off at a media center on the third floor to see about an overhead projector for Peder's demo. She checked one out and decided to take it down to Peder in the ICON lab. I said that I would wait for her in the hall outside the media center, just down the hall from the art room door.

Watching the students in the hall was fascinating. I'd noticed as Val and I walked back and forth by the media center, that the groups of students clustered around the lockers were roughly grouped according to ethnicity. I recognized a variety of mother tongues including Thai, Vietnamese, Cambodian, French, Spanish, Portuguese, Russian, two different Eastern European languages I could not identify, Greek, Turkish, Arabic, and Persian. The students up here in the halls were not the group that were determined to

stay outside in the drizzle for that last cigarette. They were colorfully and stylishly dressed. Some were Rebok casual, but others were European stylish.

   Once again, I felt almost invisible because the students in the different language/culture groups were so involved with one another that they seemed unaware of even the members of the next nearest group. Since mother tongue use was dominant, I couldn't follow the conversations. The body language indicated that it was standard high school small talk and flirtation.

   After student watching for about 7-8 minutes, a very tall and attractive woman wearing a grey, floor length greatcoat, and long neck scarf, came flowing down the hall. She had shoulder length blond hair and was wearing a hat that matched her coat and scarf. She walked with her hands in her greatcoat pockets, taking long strides, threading her way through the jumble of students. She looked too old to be a student and too unconventional to be anything but an artisan. I thought... that is Sandi. She walked around a corner and down the hall out of my vision.

   Just then, Val walked up and said: "Well, now that I've gotten rid of that overhead projector... let's see if Sandi has arrived yet." We walked over to the art studio, went in, and found Sandi taking off her grey greatcoat and scarf. Valerie introduced us and we began a standard introductory conversation about the unseasonable weather. After the opening formula, she said: "Well, I'm sorry to be the one to tell you this, but there has been a little change in plans since we set it up for you to observe my class today. Today is the change between the semesters and I don't have a class to observe! We start back with regular classes tomorrow and I will have most of the same students that I had last semester."

   I said that there was no problem. Peder wanted me to come downstairs and observe his training anyway, so things would work out quite nicely. I asked her to show me around in her art studio. She hung her coat in a hallway between her office and the studio and started to give me the cook's tour. She showed me her MAC Plus and laser printer first.

   She said: "I've really been working with computer graphics for quite a while. Before I came to London to teach, I had a job as a commercial artist in Toronto and learned to do computer graphics on Intergraph workstations. In fact, I sort-of became the local expert on the operations of the Intergraph. I had to field strip it and carry pieces in for repairs a couple of times. I really hated that part of my work back then. It was a high pressure job with tight deadlines and every time the darn think went down, we stood to loose big bucks. So, I found myself under pressure to both turn out work and maintain the machine. Now I never have to mess with hardware problems or repairs. that is someone else's job and I just turn in a work order."

   She went on to tell me all about how the MAC was in constant use by her students doing both text and graphics to be used as part of their designs and projects. She showed me the other more standard graphic arts equipment including a camera table, presses, air brushes, compressors, drawing tables, and other assorted hardware.

She said: "All of this stuff is really old, but we're lucky to have it. Most of these drawing tables were used when they were obtained a few years ago and we could use more of them. But, we would need more floor space if we got a lot more of them. The light in her is good for art work. (There was a sixteen foot ceiling with windows all the way to the top.) Sometimes we get pretty crowded in here but we make do."

She went on to say a great deal about her father (who was the chair of an art department in a public school, her prior activities as a serious amateur athlete before the onset of back problems from scoliosis, her background working in the commercial graphics industry and her transition to education after more health problems due to job related stress.

From there she went on to say more about the problems related to getting better technologies for her students to use in doing their work for her classes. In fact, considering that I had not meant or even tried to start a formal interview, she said a great deal indeed. She talked very easily and seemed willing to tell me her whole life's story right then and there.

Toward the end of the conversation, Val asked her to tell me about an "event" that had happened in her class a couple of weeks ago, involving a generalized crash of the network. Sandi said: "We were using SPECTRICON for the first time with the class and some of the students had been working on initial efforts to do color graphics on the Icons. They were used to doing computer graphics in black and white on the MACs, so some of them were doing pretty complicated compositions. Something happened and first one terminal went down, then another, and another... Until finally all but two of the Icons had crashed or frozen up and lost their graphics that they were building. I think some of them had saved or were trying to save at the time that the *melt down* occurred. We never figured out what caused it, but it makes all of the students really careful about saving their work."

Val caught my attention by looking obviously at her watch and saying: "Well Sandi, we know that you want to get some work done. So why don't we re-schedule Bob's observation for the next available day (Thursday) and go ahead on down to observe Peder's training class in the lab downstairs." We arranged with Sandi for me to observe her next ICON class on Thursday afternoon. We said good-by and went downstairs.

ICONS in Fine Arts Education
(Field Notes: 4-11-89)

Note: YL = Young Lady and YM = Young Man

Margarete is talking to incoming and outgoing students and putting a color wheel up in front of the room that I assume she will be using on the next lesson. She's telling the students in the incoming class that today is "absolutely the last day" for the current assignments to be finished and she wants the work turned in by period's end so they can go on to the next project.

Margarete: "_____,... what about your art history project?"   Student: "Well, uh... I'll have it tomorrow."   The interaction pattern repeats with four or five more students.A female student (YL1) stops to show her some sketches and discuss her work. She also discusses a college that she's visited and seems to be suggesting that the student check it out.

   The team has changed. Marshall is in and Val is out.   Students are still coming in and handing in due or overdue work.   At 11:42 there are about 13 students present. About six are started doing some sort of art project. They appear to be working on hieroglyphics and other stuff that is thematically related to some Egyptian relics that are being built for the school "show".

   YL1 is going to paint on a large pharaonic wall painting that is near my temporary table site. We had to move some stuff around so she can work. No problem.

   The teacher said that two students were to be working on the computers today. The two designated went back into the ICON booth. The regular class all started on their respective projects (11:47). I'm floating back into the booth.

    I've moved the workstation to the back so I don't disturb YL1. The teacher is talking with the class about pyramids and scrounging jewelry for the show... Egyptian jewelry is hard to find...

   The boy (YM1) working on the ICON was adding to a surrealistic pyramid motif piece he had saved... but he didn't like his modification and ditched it. The girl (YL2) is having a hard time starting a graphic drawing. She said "... yours is really nice. I'm having a hard time. I don't have much experience with this." She's <u>fooling around</u> learning to use the features.

  Margarete chased out a third student (YL3) who was talking to both students on ICON. YL2 mentions that she had an elaborate drawing on the Library computer and the thing crashed on her. (A discussion ensued between researchers and teacher about other bugs and crashes that have occurred with the graphics program.)

    YM1 has started a new drawing. YL2 is still building up the upper left hand corner of her screen. Marshall, Margarete and I were all in the back room. Margarete left saying "Well...   these guys don't need three adults watching them."

   In the studio two students are painting on a giant poster of hieroglyphics, etc. Two boys are collaborating on another similar poster near the back. YL3 is still off task and there is generally an informal atmosphere in the studio overall.   YL3 wandered out of the room. The teacher is helping YL1 mix tempera. A late student (YL4) just arrived and was asked by Margarete to go "sign in" and come back. YL3 floated back into the booth. Margarete said to YL3: "_____, time line!!"

   YL3: "I'm getting there! It's stupid! I don't know what I'm doin'!" (i.e., commenting that she did not understand the time line assignment).

YM1 is apparently doing a street layout in perspective. He's outlining the scene with white lines on a black background. He's apparently figuring out his idea on the fly.

YL2 is still playing with features on the ICON. She doesn't yet have anything resembling a composition... but more like a pad full of doodles.

The teacher went out of the class momentarily and came back with a roll of brown paper. She announce to the class that people that need the paper should get pieces the right length and cut them off the roll.

Students who have been working on the big black-on- white posters are now trying to put their work up on a wall. YL4 came back into the class.

The teacher is trying to keep a student from falling over backwards while she is stapling up a poster. She's also trying to help the two boys who were collaborating on a poster to find a wall space for theirs.

Margarete floated back into the booth and asks "How are you guys doing??" YM1 is starting to use color fills on some parts of his drawing. The teacher checked on YL2's progress and intervened. YL2 was having trouble erasing and Margarete showed her an area erase procedure. YL2 then used the procedure after Margarete left to clear some more doodles off the screen. YM1 <u>seems</u> more self directed and sure of what he is doing. The girl <u>seems</u> more tentative and still doesn't have anything clearly resembling a composition.

The teacher is now helping the two boys tack up their poster. Lots of "ladder work" going on. YL3 is looking at a source book containing drawings of the Egyptian gods. She asks Margarete to comment on what she's doing and Margarete refers her to another source book.

Three boys putting a poster up. YL1 is still painting. One cutting cardboard. Two working on gold wrapping paper. Three painting a prop. YL3 is doing research and YL2 & YM1 in the booth. The teacher asks this class if they can put up posters for the production around town: " Can your mums and dads put them up in the work place??"

YL1 is cleaning up.

YM1 is still working to fill in more of the areas that he has blocked. YL2's doodles are accumulating into a kind of eclectic composition. Themes are the word ART and a kite. She shows good functional knowledge of using the various color pallets. Some features she seems to know a lot about. Some she is apparently unaware of.

The teacher in back room: "Anybody need help?" No response. She then goes outside into the studio and says: "Be sure and watch the time. Don't anyone leave dirty paint brushed lying around." The students are already cleaning up. The studio is winding down. The computer art students are still working intently.

"Is it time to go??" "Yeah. It's time to go. Everybody put everything away!" The students in the booth are asking Marshall some questions about the graphics program. He's helping out as needed. He answers questions but doesn't offer much more than direct answers. At 12:42 YL2 leaves. She talked to the teacher on the way out and Margarete asked her if she was sure that she exited so that the work was saved. At 12:43 YM1 left and Margarete also asked him if he exited and saved.

(Contextual background from field notes: After completing the first observation in the fine arts education classes, the RUCCUS project's art education specialist Roger Clark came through the school and took the art teacher to lunch. From my own discussions with Roger, I knew he was providing the art teacher with planing support and that he was pursuing his own data gathering activities concerned with the ICONs and art education.)

Distributive Computer Aided Learning

It has become relatively commonplace to discuss the technical and logistic significance of local area networks for supporting the instructional use of microcomputers. A local area network (LAN) simply connects all the workstations in an installation to a shared data path through some sort of coaxial cable, twisted wire pair, or a modular telephone wire (Bright, 1988).

The installation a LAN enables the shared use of network printers and file servers. File servers permit data files and multiple-user software programs to be loaded into individual work stations through the network. In effect, a file server functions as a shared, high capacity disk drive, attached to every microcomputer in the network installation. This means that one printer or one installed copy of a legal, multiple user application can can service multiple microcomputer workstations on a LAN. This eliminates the cost of multiple printers from the lab installation and improves the speed and efficiency of software distribution to the end users.

For several years, a shared assumption common to many school microcomputer installations has been that individual workstations should be housed in secure, centralized lab sites. *The Electronic Schoolhouse* (Cline, et. al., 1986) was one of the earliest serious works to discuss policy and practice concerning the curricular integration of microcomputers. Referring to the initial IBM/ETS dissemination project undertaken in 1983-1984, we find the following:

> The program plan specified that all donated PC's be kept together in the high schools in centralized labs. (p. 28)

> ...suggestions were made to the high schools concerning security. This advice included: (a) having all the equipment gathered in one room on the second floor, (b) securing all windows and doors against unauthorized entry,.(c) restricting all off-hour access through building coordinators, and (d) using other security precautions such as bolt-down systems, burglar alarms, or additional security personnel. (p. 31)

Attention to administrative details like security, air-conditioning (to avoid heat build up in sensitive equipment), providing lab aides or site managers to assist with the mechanics of a new technology, and scheduling shared access to a limited amount of hardware has meant that microcomputer laboratories are the dominant hardware configuration in U.S. secondary schools (Becker, 1986).

   The art education class described above details a significant departure from the typical centralized lab site. The individual workstations were installed in mini-sites within the classrooms of the cooperating art teacher.   Individual students were rotated on and off of the ICON workstations.   The ICONs were used as graphics production tools for specifically devised art studio assignments.   The particular computer-based art projects were thematically and contextually similar to the projects undertaken by the majority of the students working with traditional art media and materials.

   The behavior of the classroom art teacher did not differ significantly in the way she addressed and related to the students engaged in traditional art or computer-based art projects. She rotated or *circulated* throughout the classroom, answering questions, demonstrating techniques, and offering encouragement and direction to all the students. While the particulars of her interaction with the computer artists was occasionally technical in nature, her role in the whole class was clearly that of a facilitator and mentor for all of the student artists.

   In summary, the art education described above is distributive in two distinct ways. The microcomputer installation in the fine arts program utilized a distributive network with shared microcomputer resources and the teacher equally shared her attention among the students working on both traditional and computer-based art projects. Both of these distributive attributes have a significant impact on the pedagogy and instructional outcomes[2].

<div align="center">

Microcomputers in Commercial Art Education
(Field Notes: 4-13-89)

</div>

   I'm at Tecumseh and entered Sandi's class (meeting in the ICON laboratory) a few minutes after the period started. Sandi is floating around the room helping various students play with features. Just a second ago a student was overheard to say "I am playing! I want to play with animation!"

    One student is at the center table cutting out from magazines. Everyone else is on ICONS...

   It looks like Sandi has shown them where the clip art is and quite a few of them are using it to experiment with. Three or four I'd say... Two of the girls have found the cross words program... One is doing a cursive name (YL2)...

   The young lady doing the name (YL1) is erasing a circle she got accidentally. Sandi working with the girl sitting at the terminal next to her. She is apparently having a hard time getting used to the tool. She's doing a lot of 1 on 1 support with her.

Sandi has taken over the screens using ROBOTEL. It routes the video output from a selected workstation into all the ICON monitors so they see her screen. (When she kicks in the ROBOTEL, there is almost and audible SNAP and the students look like they've been hit. They don't like to have control over their work stations taken away from them.)

She has designated control over ROBOTEL to YM1, who is taking them thru a demo of IPAINT II II.   Sandi is explaining the limits of the program (ten frames) and letting the student (YM1) do the demo. (Marshall has set up their fancy tape recorder. The external mike makes it really obtrusive but I'll bet it cuts a good tape.)

Sandi has moved the control of ROBOTEL back to her own terminal. Now she's doing the demo. She has drawn a box (2D) and is doing a series of frames simulating the rotation of the 2D figure. The lines in the shape always have to be drawn in the same order. (The students can't WAIT to get control of the program themselves. Overheard: "This is some kind of wonderful machine!")

She's getting closure on the demo. She tells them that they can also create a background scene for the animation to overlay on.

 One boy is still into the crossword. Two of the girls are still using SPECTRICON. Everyone else is getting into IPAINT II.

I wandered over to ask Sandi if IPAINT could fake a 3D figure. She said yes and explained to me how it could be tricked to rotate a 3D figure or blow a figure apart for a dramatic effect.

She explained that she's intentionally letting them PLAY AROUND including look at the other stuff on the server. She says that because they've used Cricket Draw etc. on the MAC, she gets them right into IPAINT because it lets them do some different stuff. Six students are using IPAINT.

 The person in the middle that was cutting pictures is leaving. (Maybe a non-student?)

Sandi is talking two more into IPAINT (incl. YL1) through AMBIENCE (the ICON Operating System; a bright blue background).

 The majority of the students leave with Sandi to go and sing happy birthday to another of the art teachers... taking a cake along. Two students stay behind and continue working.

 Sandi and company have come back in and the students are "playing" with IPAINT and a few other assorted programs. (Some of the students have tried the drill and practice software that is available through the network and AMBIENCE. They never seem to stay with the drill and practice programs or more traditional instructional software for very long.)

YL1 finally got her simple animation to work. She was really pleased with it and did it over three of four times. She said: "Wow! Where was this when we were doing film last year!?! I had to do 130 drawings for how long?? A minute and a half??"

Two of the boys go out. One comes back and asks if the room upstairs is open. Sandi says yes... that one of the girls is working up there on the MAC.   Another girl (YL3) comes in to ask Sandi a question about what she is working on. Sandi works with her 1 on 1 at the center table.

(Sandi explained to me that YL3 is a student who is very talented and has a spelling and writing disability. She told me that she really can't spell and doesn't get the sort of help she needs to remediate the disability so she can work up to her level. Sandi has made herself available to YL3 whenever she needs any help working out Art or any other assignments.)

Five students are using IPAINT... one is doing a drill...   and one is using a program to build up a seashore with shore birds and plant life.

YL2 (did the cursive name) has animated a simple wing flapping. She says: "Sandi... am I through with the assignment?" Sandi answers: "No... you have to find a commercial application for it. You have to explain its use to us."

YL1 is still working with her animated wing and talking... "We have to find some commercial use for this? I wonder what we can use if for?"

Sandi's students are starting to save and clear out.   Only three students are still on. A YL4 asked Sandi's help to figure out how to save her figures. She asked: "Is today a play day? Do we get serious tomorrow?" Sandi: "You were supposed to fool around with it today and discover it's capacity.   Tomorrow you can work with it."

Sandi is helping YL4 log off after an extended 1 on 1.   Help. She's chasing students out. She says that she has to get outside for the track practice. The art teacher leaves to go and coach track.

A Commercial Art Studio
(Field Notes: 4-14-89)

I am in Sandi's classroom/ studio. There are six students in the room. Five are at drawing boards working on individual projects and one young man is working on the MAC. Their cassette player is playing heavy metal music. Sandi is looking for something in her office. She just entered the classroom..

One of the students immediately asked her a question about the animation program they used yesterday. YL1: "Do I have to change my drawings to accommodate the program?" Sandi: "No, but you have to work it out on paper and acetate before you put it into the animation program. I don't want you to change your idea to fit the computer program, but I want you to work it out first. You have to be all prepared when we have time on the computers so you can make maximum use of your time."

YL1 goes on to explain her idea about a truck ad.   Sandi:" Today is the day I'm going to explain your new project to you.   Where is _____... Where is _____... (She's taking attendance.) OK... _____ is the other one that is doing that..."

YM1: "So... are you going to explain this thing to us before 10:00??" Sandi: "Yeah, I'm just trying to wait for everyone to get here first." The students are continuing to work. The students are anglo except for one black student. Three males and three females are present.

Sandi:" You can turn the music off now. I just want to go over what we've got going now. We've got the illustration and the animation piece."

A discussion is going on about access to the computers. Sandi is explaining to them why access to computer is limited to certain class times. The students want to know why they can only have access at certain times.   "We're really taking advantage of the situation now because a lot of teachers in the computer program haven't figured out how to use them yet in curriculum. I've used computers for graphics so I'm ahead of them in getting started.   That way, we are getting more computer time in."

"You only have ten frames to work with so you have to plan your drawing carefully..."

(She has drawn #10 and a diagram on the board showing ordering of lines in a drawing. She has accumulated three diagrams illustrating consequences of line ordering.) "So what we have to do is start numbering out lines on the roughs so that we can always order them in the same sequence. From the drawing we will move to acetate so what we can register the lines. We all know how to register a drawing, right??"

Sandi goes on to talk about the acetate phase of the planning and doing a drawing transfer to acetate thru a photocopier. "The idea of this assignment is that you will do some commercial application of animation. I don't just want shapes moving across the page... I want to see that there has been a lot of thought given to manipulating the images on the screen." (She goes on to combining figures to have more than one figure on-screen].)... She explains that if you want more than 1 figure on-screen you have to draw combined-connected figures. You can't separate them.

YL1: "If we move a figure in front of the background, is the background erased?" Class answer: "No, it stays in front of the background."

Sandi: "At the same time we are going to be working on the illustration assignment. It is going to be done in wash..." (She writes illustration and text up on the board.

The other student... YM1 comes in. He has his portfolio.   Sandi is explaining that their illustrations can be illustrations for a book -for instance- but that it has to be well researched. "You must have a **comp** and it must be done in marker!"

Student: "You're cruel! We can't make mistakes in marker.   Can't we use pencil crayon?" Sandi: "No you have to use marker.   That's they way they want it done in commercial work.   I'll bring in some examples of marker comps tomorrow... You also need to give some careful though to how you're integrating text into the illustration... You have to put your entire illustration and text onto a grid..." (This entire sequence is about **planning** the illustration layout.) "What do we do about contrast between the text and the illustration...".

YM1 is working on the MAC the entire time Sandi is explaining the assignment. Some of the other students are continuing to work too.

YM2- the black student- asks Sandi about an idea for his illustration. Sandi is now showing some sample commercial illustrations. Sandi is showing examples of compositions and explaining the tricks to each and particularly going into details on what techniques were probably used to create the illustration.

(Sandi is holding up an NTEL ad.) "What message do you get from this illustration?... Where are you going?...   Can you wait for just two minutes? (They give a good answer about space and friendliness and simplicity.)

The YM2 is still holding before going to make his call.

She directs them to some books as examples; incl.   Sendak.) "I know _____ is anxious to go make his call, so you can take a short break early today." The students don't change what they're doing very much.

(Class takes a 10-15 minute break)

Break has been dragging on. Sandi is calling the class back to order despite the fact that some of the students are still missing. Three students are present.

Sandi gave me a copy of her last classes "magazine" to look over. A girl comes in from the hall and joins the class; wasn't with previous group.

Sandi is seated with the four students in the center of the room. They are going to do a demonstration of using wash. YL1 speculates that they have "... used wash before. They don't want to be told how to do it again."

One of the YL's from the first part of class came in... and another who wasn't there but was in the computer lab yesterday joins the group.

YM1 comes in too.

Sandi: "So... we can control the wash just by controlling the consistency of the pigment in the water... It all has to do with the consistency of the water...

You see how I can start layering?... It is basically like what you can do with water color... "

"But what we can also do is by controlling the consistency of the paint, we can control the spread of the wash.   What I usually do if I want an opaque area I paint the wash and let it dry. Then I put another coat over it."

The wash demo is going on. They're watching her and she's explaining to them what she is doing and why.

YM2 comes back in "... they couldn't get through." Sandi continues demo.

YL1: "If you **do** make a mistake when you're doing this, can you paint over your mistakes?"

Class: "No. You have to do it over again."

Two gentlemen come in. They look very official and ask to talk to Sandi a.s.a.p. They go to wait in her office. She tells them that she'll be with them in just a minute. 11:07 Sandi goes on with her wash demonstration. 11:11 The demo is still going on.

Sandi: "I want you guys to experiment with this and I'd like for you to do it right now. Play around with it. I want you to know what it is capable of doing."

Sandi goes into the back room to discuss whatever. The students shuffle around through the transition and gravitate toward their workstations. YL3 is now using the MAC.

 The students are starting to work again... YM2 wanders out... 1 student on MAC... 1 looking at mag illustrations... 3 looking at and commenting on the content of a drawing.

One student is experimenting with wash. YL1 leaves at 11:22. Sandi and the two gentleman come out of her office and look at a poster that YL3 has done and has in her portfolio.

Sandi gives the class a good explanation of her discussion with the <u>printer</u> in the back room. The other guy was from graphic communications. They were clarifying a misunderstanding about a rumor that her students were doing a commercial typesetting job using desktop publishing. (Possible paranoia from local graphic arts and publishing interests that aren't up to using desktop publishing.)

Sandi is working with the student using the MAC. Three female students are in the room with Sandi. The period ends.

Before leaving, I initiated a discussion on scheduling future visits and interviews with Sandi. Before leaving I gave her some student permission forms and explained that I'd probably observe Monday and Tuesday of nest week, then try and do interviews. I asked

her to basically pick the kids for me and see if they would volunteer. We scheduled an interview for her at school next Wednesday.

Integration of Technological Tools and
Commercial Graphic Arts Curriculum

   The two commercial graphic arts classes described above provide a contrasting portrayal of microcomputer use in art classes. Several important differences exist between these commercial arts and fine arts classes. The students in the commercial art curriculum are more experienced as artists and generally older than many of the fine arts students seen during the earlier observation. The commercial arts students displayed a higher overall level of "computer literacy" and more specific experience using graphics programs than their counterparts in the fine arts classes.

   The curriculum objectives in the commercial arts classes are oriented toward application of techniques to simulated graphics production activities. In contrast, the curriculum objectives in the fine arts classes are oriented toward a balance between "discipline-based" art education and development and application of studio techniques for creative self expression. The commercial arts curriculum is oriented toward development of vocational skills while the fine arts curriculum is generally oriented toward knowledge about art history, visual aesthetics, and sampling the range of artistic styles and techniques available through the study of our heritage from the visual arts.

   In addition to differences in the background of the students and the respective curricula, there are major differences in the way that the ICON LANs are set up for student usage. The ICONs in the vocational high school are set up in a centralized laboratory setting that is shared by all the teachers in the participating classes. This meant that there were sufficient ICON workstations for the entire vocational art class to work individually at learning to use the animation tool (IPAINT II). This allowed the teacher to demonstrate particular techniques to the entire class with the aid of the ROBOTEL device and exert more control over the pacing of demonstration and practice activities within the lab site.

   In both settings, student activity was highly individualized and both art teachers supported this individual activity by distributing their support activity throughout the group of students under their supervision. However, in the classes described and in other observations made during the study, there were more frequent group-focused demonstrations of technique in the vocational art classes than in the fine arts classes. In addition, the vocational graphics classes made use of group presentations and critiques as part of the studio routine. This was true with both traditional graphics arts techniques and with computer graphics techniques.

   Some differences between particular observed classroom behaviors of the art teachers in these cases may be attributable to curriculum objectives, student backgrounds, or to the philosophical and instructional differences between contrasting comprehensive and vocational high school settings. Despite these differences, the broad pedagogical similarities are striking.

One outstanding similarity is obvious in the two observed situations. The art teachers in both cases displayed similar *circulating behavior* while they were monitoring student studio work. They typically moved quickly and smoothly around the studio or microcomputer lab setting, answered questions, offered assistance when requested, commented supportively about the students' efforts, and only occasionally redirected students efforts if the observed activity of a particular individual went outside the established boundaries for proper technique and conduct.

Is this *circulating behavior* a central attribute of art education or an attribute of an evolving pedagogy for interactive technology? Seemingly, in both cases the teacher's role is oriented toward support and facilitation of individual student activity rather than toward more traditionally teacher-centered instructional activity. Or, could this *circulating behavior* be a particular attribute of local area networks?

In a classic case study of computer aided mathematics instruction on the networked University of Illinois PLATO system, Bernadine Stake observed similar facilitating behaviors and movement patterns displayed by a fourth grade teacher (Stake, 1990). Other naturalistic studies of computer aided learning portraying apparently successful technology interventions suggest that use of computer aided learning encourages new forms of interaction between teachers and students (Blomeyer and Martin, 1990).

What is the common denominator here? Does the technology support or encourage an interactive pedagogy or would these art teachers use the same strategies regardless of the fixtures in the setting? Or, are there other unobvious influences molding the ways that these two art teachers integrate microcomputer technology into art curriculum?

<u>Supporting a Technological Innovation in Art Education</u>
(Field Notes: 4-17-89)

I am in the ICON booth at the back of the art studio in the comprehensive high school. One of the female students using the SPECTRICON program has <u>locked up</u> her ICON. Margarete and the girl are trying to figure out what to do. She tells me about how this has happened a few times before and makes jokes with the YL (YL1) that it never happens twice in the same period.

I settled in after meeting a student from U of Western Ontario that is on a teacher practicum assignment. At 12:02 YL1 comes back and restarts the ICON. She finds her way back in thru Ambience. Her work IS gone. SPECTRICON is version 1.01A. She's back to a clean slate.

The art studio is as predicted... Margarete mixing paint and listening to a student talk about his or her work... Margarete circulating around the studio and making a pass through the ICON booth. The students are all working steadily on their art projects; on and off the computers.

The second student (YL2) has frozen her screen; <u>locked up on SPECTRICON.</u>. She has lost her cursor and called for help. Margarete came to her assistance and had to switch it on and off.

Margarete was explaining how to use the ICON features to select the color palette. Then she went out to work with the art studio.

YL2 asks me if it is OK to restart the computer. I say yes. I talk to YL1 about saving. She says that she doesn't like what she's done anyway. She asks if I know how to save. I say no. (I suspect she's really used to Val and Marshall answering requests for technical information.) YL1 goes out to look for Margarete to ask her how to clear the screen... I think.

YL2 is back into SPECTRICON.

The students out in the hall are passing. It must be the break in the periods.

Margarete comes in with YL1 and shows her how to do full screen erase. Control F10. She also shows how to use black circles to overlay another circle. She also shows how to use the paint brush as zone erase.

YL1 how has a clean slate. Margarete now goes to work with YL2 and shows her how to change her color palette.

Margarete's pre-service student is floating around the lab pretty much as she does. YL1 is experimenting with the air brush feature.

YL2 is going back in an has a pretty well developed composition already. Rectilinear and ellipsoid shapes on a white field. She's using the magnifier to look at the pixel patterns and work on the fine grid.

Margarete wandered in and out with some paper work. Six students are now in the center of the studio... two are working and four are watching. A fair number of students are wandering around. One YL (YL3) wanders into the back and kibitzes with YL1.

A blond YL (YL4) comes into the back and announces that YL1 & YL2 need to work with her on a ceiling mural now. Margarete tells YL4 that she should go on without them because they get their two or three days on the computer projects now.

YL3 wanders into the ICON booth again and talks with YL1 about SPECTRICON. YL3 complains that there aren't enough selections for controlling the screen.

Margarete comes back into the booth. YL2 asks her about the intensity scale. She reminds them both that it is time to save. She lets YL3 explain saving the files.

(Excerpt from Field Notes: 4-18-89)

Margarete was explaining to me that for the last half-hour she would let the pre-service teacher take over the class. That is the way she handles it normally. She's not in the studio now... but in the ICON booth. The student teacher is in charge. 11:03 Val has been in the room observing and wanders out.

YM1 has used the copy and inverse feature to duplicate the pattern of his figure drawing. It is evolving into a busy composition the symmetry is interesting. 11:05 Another male student comes in to kibitz YM1 and YM2. He shows YM1 his poster and brags that he did it in only 20 minutes total before the project was due.

The studio goes on. The student teacher isn't interacting much with the kids. She tends to wander around and watch what they're doing but she doesn't talk with the students as much as Margarete does.

YM1 is putting some subtle variations on his figures. Two girls came back to kibitz. Ones said: "That looks real good _____. When I did it, I kept breaking it... the computer. I didn't mean to, but I just did."

I just noticed the student teacher (ST) talking with a student about her composition. 11:13 YM2 wanders out and comments on YM1's composition. "Terrific!"

I just commented on a fill that YM1 was doing. YM2 comes back in. He's returned with an art history book. He's apparently looking for an example of something. He had been trying to do some background.

Peder appeared and came back into the ICON booth. He had a look around and asked me to come up into the library and talk with him some after this period.

YM2 Locked up his ICON! He was using the line drawing feature. I'm sure that is the trick!! He said that he thought it happened when he was moving the track-ball and hit the action key at the same time. He said it happened to him yesterday too. He said his picture was saved.

YM1 also saved his picture. He asked about saving and went through the drill. When he was finished, he was about to turn it off... I stopped him and made him back out to ambience. He left the booth.

11:25 YM1 is back into his picture and working again. 11:27 He backed out and quit. The class is getting ready to change. Margarete is back. Val came through to tell me Peder is trying to solve a printer problem up in the library.

 Margarete and I talked a bit about the last LOCK UP. A new class was coming in. I said that I was going to go up to the library and talk to Peder.

I left Margarete's classroom and went up to the Library. He had a variety of things that he wanted to tell me... that the facility to video record ICON screens using the ROBOTEL was about ready. (He was afraid that I'd wanted to record some kid's sessions and been unable to. I assured him that it wasn't important to me, but that it was to the project.) He said the reason it is hard is that the RGB output isn't standard and converting it to composite is taking a special hardware device.

We also talked about the SPECTRICON bug. I relayed the information I'd observed from crashes from earlier in the AM and he recreated the crash. I'm pretty sure the developers can find the bug now that Peder knows how to recreate it.

Margarete came up into the library and asked Peder about a few things: 1. Question about power failures. Peder said we had discussed the issue the night before and that he was working on it. 2. Question about graphics film he had used for the training. Peder said he would help her get a copy. 3. Question about IPAINT. Peder told her it was installed and showed her IPAINT. Margarete can't wait to use it. After their brief conversation, Peder left the room.

12:10 Margarete and I left the library and are both back in the art room... in the booth. Both YL's have developed nice graphics during the interim. The class is doing a normal studio... The students are pretty well gone from the room now. I think less work got done with the ST in the room and Margarete gone.

Margarete is working with both students in the booth. She showed the near YL (YL1) how too use the UN-DO feature. She goes out of the booth: "Where ARE all of our students ??"

The far YL (YL2) is using the line feature. No ramping or other textured background. I'll watch to see if it crashes...

Support Structures for CAL

Clearly, when any technological innovation is brought into the schools and used by teachers in authentic instructional activities, there are going to be difficulties and opportunities for the teachers to gain practice at solving a range of technical and pedagogical problems. Scenes where the SPECTRACON program crashed on multiple workstations were observed in both the distributive classroom environment and in the larger laboratory setting. After the teachers and project research staff had sufficient experience with these "crashes" to describe and even recreate the conditions that seemed to trigger the events, institutional support structures were mobilized to minimumize the negative impacts on learning.

Special expertise was available to support the project teachers from both the local School Board and from the faculty and project staff at the University. The board liason Peder Neilsen worked very closely with the RUCCUS researchers and was constantly in and out of both schools as an on-site consultant and trouble shooter. He was also the primary trainer who conducted the pre-service and in-service education for the cooperating teachers.

During the period of my fieldwork in the local schools, I also became a defacto member of that support network. The possibility that technical difficulties might occur during my presence in the setting was discussed with Peder Neilsen, the cooperating RUCCUS researchers and Ivor Goodson, the project's director. In our discussions we considered acknowledging a distinction between interventions of a primarily technical nature and other types of interventions that might undermine the autonomy of the classroom teacher

or influence them to modify their behavior to accommodate the perceived values of the researcher.

In short, were I to be present in the setting when a technical problem occurred and if I had a technical fix that would repair or minimumize an interruption in the student's instructional activity, I was authorized to communicate the information directly to the student and help solve the immediate problem. Additionally, Peder Nielsen and the project staff expected me to share information with them that could reconstruct problem scenarios and aid in their analysis and solution.

The analogy that we used to justify these technical interventions was the ethical comparison to a medical doctor who may encounter an accident victim. If the profession of the doctor is known to onlookers, then a lack of appropriate remedial action on the expert's part might put the physician's professional commitment in question. This ethical dilemma led me to initiate some technical interventions on behalf of the students. For instance, in the scene described above, I reminded a male student (YM1) to back out into AMBIENCE before saving his work. Implications of these local interventions will be discussed in the concluding section.

The Pedagogy of CAL: A Training Group in the ICON Laboratory
(Excerpts from Field Notes: 4-19-89)

Peder is demonstrating WRITE on the ICONs. He's using the ROBOTEL to do a "show and tell". He's showing tricks (like hanging indent, etc.). He's just finishing his presentation of WRITE.

One of the teachers asks how she might set-up files so she has room for marks in the margins. It apparently has lots of room along side the columns for extending the work space. He shows how to put in an extended margin so there is room reserved for the teacher to put in marks or comments as an overlay on the student's document. When marks are put into the left margin, they have to erase the extra spaces that are inserted.

Peder: "There is much more for me to show you but it will be best if I don't show you these advanced tricks until the need arises. That is my intention in being available to work with you individually in your schools. Save your questions for when I'm in your schools and ask me about your individual concerns then."

Another teacher has asked Peder how to make different versions of similar files... i.e. boilerplates. Peder also says that WORDPERFECT will probably be better for that application than WRITE.

Peder is demonstrating another DEMOCALC feature. He's showing them a filename trick so that the program automatically saves their work-file under a slightly different name.

He says that they may be at the point where in that next semester they will want to create a "template file" for their students to use in their assignments.

He is stopped by a teacher who asks what the trick is to get out of the "file" area in the application. The person has apparently gotten caught in the file option with out naming the new file. This prevents and exiting the program.

He's asked some graphing questions. The use has to cut out columns of data to create a graph. The column is then re-inserted with a "insert last column" feature... a kind of column undo.

Peder return's the ICONS to the teachers and suggests that they "play" with DEMOCALC and try and develop some problems so they can ask questions. They start and he floats around the room attending to various teachers individual concerns.

[Note: the emphasis that follows was also present in the field notes.]

(It strikes me that his lab-assisting behavior is just like the art teachers behaviors in studio and PARTICULARLY like Sandi's behavior in the ICON lab!! He circulates in the same way that Sandi does, observes the students work, and intervenes to remediate or demonstrate procedures as needed. This is the normal operating mode for art teachers, science teachers, industrial arts teachers, and music teachers (when they are in a highly individualized, group learning environment). Could it be that this is something fundamental to the pedagogy of technologies?)

He's still attending to the same teacher's DEMOCALC question.

He's floating to the other side of the lab. Valerie is up and floating too.

Peder fields a question about entering and centering cell data. Cells can only be right/left/center justified one column at a time.

Most of the teachers are doing budgets. One is building a grade book for a class. He's put in all his students and is counting up grades on his fingers.

Peder is moving some things around in ICON setting up the next part of the demo. One of the teachers tries to get his attention again to address an individual concern: "PEDER! PEDER! You're going to have another broken computer soon!" Peder goes over and answers his question. The trainee seems very literal minded and unable to learn by TRYING. He wants to be shown explicitly how to do everything he's interested in so that he doesn't have to RISK making mistakes.

One of the trainees is doing a graph of the "energy consumption" assignment... That is what the majority of them are doing. It is possible to type text directly on the screen to label the graph. This makes the user interface very easy to use.

One of the more experienced trainees discovered that it is not possible to save a labeled graph screen. Once the graph is labeled, the user has to print it out immediately because it is totally lost once the user goes back to the rows and columns.

Peder has kicked in ROBOTEL again. He's doing a presentation on the "replication" feature. He's showing how formulas can be replicated to do uniform calculations doing a function of either a whole row beneath data or a whole column along side data.

Peder is giving an important message to the teachers...   "The reason for using these tools... word processing, spreadsheets... is to save you a bit off work! It is to do some of the stuff that takes up your time that is difficult for you now." He illustrates with a story about using a spreadsheet to keep track of his bank account; uses anecdotes about his experiences to make his point about using technology as a tool.

<div align="center">The Impacts of Modeling on Technology Application</div>

The training anecdote given above had a profound effect on my perception and subsequent interpretation regarding the sources of *circulating behavior* and interactive pedagogy observed to be a central part of the classroom routines of both art teachers. It became clear to me that the two art teachers were using the microcomputers in class the same ways that they had seen them used during their training sessions with Peder Nielsen. Circulating behaviors, supportive interaction, facilitating behaviors, and instructor participation in situational problem solving were all modeled in the training classes.

Peder Nielsen's training sessions were based on the teacher-trainee's participation in a variety of application task structures that were illustrated by anecdotal explanations and contextual elaborations. This information made the task structures as realistic as possible, engaged the learners in reality-based practical simulations, and encouraged all the teachers to apply the new techniques to problem solving. The problems they engaged were like those that they might reasonably encounter with their own students while using the ICON system and its graphic tools.

<div align="center">Student Voices[3]</div>

Tell me about yourself. Why are you in this class? What is your art medium of choice?

Commercial Art Student 1: I started by taking a course at another high school and going through an application procedure. I don't consider myself to be a "fine" artist. I do studies. I prefer traditional drawing materials and wash as media.

Commercial Art Student 2: Art is only something I've done for the last 26 months.   This is a career change for me. My husband has opened a trucking business and I started the commercial arts course because of possible linkages to his business.

Commercial Art Student 3: I like presenting information to people in pictorial form.   I want to be a fine arts teacher. I work in a variety of media.

Comprehensive Art Student 1: I love art. I love anything that is expressive. I have trouble writing and I love anything that will help me express myself. I love to draw and paint.

Comprehensive Art Student 2: I like to draw. I'm a business major. Art is just a hobby for me. I like to sketch and do water colors.

Comprehensive Art Student 3: I'm not planning on art as a career. It is just a hobby for me. I like to draw. I like acrylics and using conté.

When did you first encounter the use of computers?

Commercial Art Student 1: I had a C-64 (Commodore) at home. I had it for years and got bored with it. C-64's also appeared in the London schools my last year. "Play along and learn games." No serious instructional use. No big deal.

Commercial Art Student 2: I took a computer course at Althouse. It was a basic level course. It didn't make me feel very comfortable using computers.

Commercial Art Student 3: I was in grade 10 when I first encounters a computer; in my mother's work place. The second time was here in Sandi's room.

Comprehensive Art Student 1: I used a Commodore Pet 2000 in grade 6-7. We used it for word processing and computer literacy. It was in the hall shared between three classes. I used it once in two years.

Comprehensive Art Student 2: I have an APPLE II at home. My parents bought it for me to use in school.

Comprehensive Art Student 3: My neighbor got a C-64. We played games on it. When I was in the 6th grade we had some Pet Microcomputers. We used them for spelling and math games. I also used computers for writing in an enriched English class and used them for music theory lessons in music classes.

What sorts of things have you done outside school using computers?

Commercial Art Student 1: I played games on my C-64 and learned some BASIC programming. I learned by typing in games from magazines.

Commercial Art Student 2: I learned to program in BASIC in the teacher education course. We also learned a little word processing.

Commercial Art Student 3: No other experience.

Comprehensive Art Student 1: I have an Atari... a game machine. that's a computer of sorts. But I'm not one for video games. That's a waste of money.

Comprehensive Art Student 2: I have APPLEWORKS and MOUSEPAINT. I used to use the word processor but I quit because my printer is terrible. Now, I mostly use the APPLE for business-related programs. I used to type in game programs and taught myself BASIC. I also took COBOL as a business course in school.

Comprehensive Art Student 3: I played games on my neighbor's Commodore. Like Skiing. We used a joystick.

What kinds of projects or tasks does your art teacher assign that require the use of microcomputers?

Commercial Art Student 1: All the projects we are assigned can make use of the computer to produce some part of the graphics. Sometimes she will give us a specific computer assignment; like a page layout or animation.

Commercial Art Student 2: I use it all the time to print out text for my graphics. But I have to lay it out by hand.

Commercial Art Student 3: I'm laying out a catalogue on the computer for a computer company here in London. We've started to learn the animation program and now have an animation assignment... with a commercial purpose.

Comprehensive Art Student 1: She gave an assigned painter and we were supposed to copy their style. Then, I recreated it on the computer with my own touches.

Comprehensive Art Student 2: The first project was just so we could try it out. We have to learn how to use it before you try anything serious.

Comprehensive Art Student 3: I was supposed to analyze the form of a painting and do it as modern art. I was doing an analysis of Rembrant. The Night watch, I think.

Have you ever had any "technical difficulties" with the ICON computers?

Commercial Art Student 1: I never had any technical problems on the ICON. I had a bad disk on the Mac. I lost all of my work because I couldn't open a damaged disk. It was a REALLY BAD experience.

Commercial Art Student 2: No problems. Just general frustration.

Commercial Art Student 3: I blew up a MAC disk. It was awful. It was a major layout assignment. I couldn't print or save. The technician and Sandi couldn't open the disk. My whole semesters work was gone. Now I back up almost everything.

Comprehensive Art Student 1: No problems.

Comprehensive Art Student 2: It stopped once. I lost the cursor and couldn't get it back. I was trying to use the perspective feature. the picture stayed on-screen but it wasn't saved. We had to turn it off and on to start over.

Comprehensive Art Student 3: Yes. Once I misplaced some of my work. I forgot my logon and password and used a general purpose logon to work. I did a drawing on the general purpose logon and couldn't find it later.   Mrs. White found the files for me and put them back into my own workspace. I understand what I did wrong.

What programs have you used on the ICON?

Commercial Art Student 1: I have used the MAC and ICON graphics programs in Sandi's classes.   The first time we used the ICONS, I went in and looked around a the courseware and the word processor... but I haven't had any time to use them.

Commercial Art Student 2: Just the graphics programs on the ICON and the Mac programs.

Commercial Art Student 3: CRICKET PAINT, MACDRAW, MACWRITE, and PAGEMAKER on the Mac. SPECTRICON and IPAINT on the ICON. We played around a bit when we were first using the ICON. There are other programs in there but they are of little use to us.

Comprehensive Art Student 1: Just SPECTRICON.

Comprehensive Art Student 2: Just the graphic program.

Comprehensive Art Student 3: SPECTRICON.

Overall, how do you react to the idea of using computers in the art curriculum?

Commercial Art Student 1: For Sandi's class, they are a TREMENDOUS time saver! The computer is a helpful thing. But I wouldn't do a whole project on the computer. It is just one of a variety of media.

Commercial Art Student 2: "I see it as a sign of the times. I think its just something the students will have to learn how to do. Computers make the work of commercial art easier and faster. "

Commercial Art Student 3: "It bothers me that there is one computer in our art room and in the computer room there are SO MANY... and we can't use them. Because we're art students doesn't mean that we don't know anything about computers. We should get to use those other machines too."

Comprehensive Art Student 1: I'm positive about using the computer... but I don't that it is any more important than doing things by hand. There's a human element to art that's the most important thing.

Comprehensive Art Student 2: It's a good idea. It could make the production of artwork much faster. It is especially good for drafting and design.

Comprehensive Art Student 3: I think for graphics it is really good. But for the "fine arts" it isn't as good. For my Rembrant... it just didn't fit. It was hard because of the kind of detail in the original painting.

What benefit do you see for yourself in others from using microcomputers in curriculum?

Commercial Art Student 1: It increases my productivity and speed.

Commercial Art Student 2: "I'm here because I want to learn how to control the computer rather than the computer controlling me! The computer enhances the capability of the human being."

Commercial Art Student 3: It gives us an edge over other kids that don't have the computer background. In university and vocationally, that will be important.

Comprehensive Art Student 1: Three things: 1. speed, 2. accuracy... ability to try things over till you get it right, and 3. more of an awareness of computers overall.

Comprehensive Art Student 2. It is a lot faster to use the computer to draw. I did that picture last week in 45 minutes. If I had done it by hand... it would have taken lots more time.

Comprehensive Art Student 3: The benefit for me is general knowledge about computers.   I would use computers if they were available to me in the home.   If I had the money, I'd buy one for myself to use at home.

What are the opportunity costs for you to learn to use the computer in your art class?

Commercial Art Student 1: None that I'm aware of... We have to learn manual drawing skills anyway. Maybe I've become a little over dependent on the computer.

Commercial Art Student 2: Yes. I have to choose now between Specials and the Fine Arts curriculum. I'm uncomfortable with that choice. I want to do fine arts... but that leads away from computer use. I think fine arts and commercial art should both be integrated with computer use. Computers have expressive applications and they should be a part of the fine arts curriculum.

Commercial Art Student 3: There are no opportunity costs. Sandi makes us learn everything manually. THEN we do it on the computer. It takes more time on the computer and quality is generally better.

Comprehensive Art Student 1: None.

Comprehensive Art Student 2: "Art classes have like a month to do this, and a month to do that. Computers can be just another part of the art class.   Just stick it in the middle. If you're done early on your water color... use the computer."

Comprehensive Art Student 3: No cost to me. We were doing all the same things off the computer. With the computer we are just working in different ways with a different medium.

If you could create your own ideal situation for using computers in the art classroom, what would it be like?

Commercial Art Student 1: I want another MAC for the classroom. There are too many people using too few computers.

Commercial Art Student 2: I think it would help me to see the practical relevance of what we are doing first. I learn better if I understand the context. I have an inductive learning style and Sandi structures the projects in a deductive manner. It would help me to see the big picture.

Commercial Art Student 3: Three or four more MACs for us to use in studio. "People come up all the time and use the computers during our class. A lot of them are doing resumes. I don't mind that... but not during our class time. Students and teachers too! Sometimes teachers will come up and just walk out with our laser printer.   Then it will come back and refuse to work for us. If you are a student working on it during class time and a teacher comes along-I NEED IT TOO! What about me? What about what I'm doing? There ARE priorities.

Comprehensive Art Student 1: Maybe a computer art course. I would like to take a more specialized course devoted to art with the computers.

Comprehensive Art Student 2: You could probably get more done with a big central site. It would be a big hassle in some ways... but you could start everyone at once and have everyone working at the same time. For learning to use software it would be easier. The teacher could clear up everybody's problems at once instead of two or three at a time.

Comprehensive Art Student 3: " I'd have it half and half. I'd have one computer per two people. then I'd divide the class in half and have half working on traditional art projects and half on the computers. I'd want the computers in the classroom. It is partially psychological... but I've tried to work in the library and I just can't get into it. I'd take down the wall too. Personally, it's like being in a closet.

Summary and Conclusion

Like most naturalistic studies, the data illustrating this case is only a tiny fraction of the amount gathered during the fieldwork. This document is a second attempt to produce a suitable report. My error in the initial version was that the study included a much larger amount of the data and assumed that the description alone would tell the story. In fact, that was not the desired outcome and I now have another way to focus the ending of the tale.

The most direct way to address the meaning or significance of this study is to summarize the information in terms of the six issues or questions that were suggested in my earlier paper on methodology (Blomeyer, 1989). The issues are restated in this document on page five. I will address each of them in turn and summarize what this case has to tell us about each of these issues. Finally, I will suggest a practical use for this and other similar case studies about technology, teaching, and learning.

Design Characteristics of Instructional Technology

The interactive applications used by the students and teachers in this study of microcomputers in art curriculum were virtually all computer graphics tools. In particular, PAINT, IPAINT II, and SPECTRACON were the three programs used on the ICON microcomputers by all the students. In addition, a variety of Macintosh-based graphics, word processing and page layout software (Pagemaker) were used by the vocational art students.

In general, most of these graphics programs used a visual/iconic interface similar to the standard set by the original MacDraw and MacPaint programs published by Apple Computer Corporation. The operation of the program is transparent from the appearance of the function selection menus. If the user wants to draw freehand, then he or she selects the menu item represented by a pencil icon. If the user wants to paint, he or she selects a paint brush icon, etc.

The selection of a graphics tool suggests that some graphic art or illustration is the intended product of the transaction between the person and the microcomputer. The tool does not have an instructional purpose inherent in its design. The instructional purpose must be supplied by a teacher within the context of a class or some other staged educational event.

Graphics programs can be used by very experienced artists or by a student novice. The mechanics of using the graphics programs observed during this study appear easy to master. In particular, the vocational art teacher had a great deal of experience using computer graphics and she was able to demonstrate and model manipulative techniques that the students could then adapt for their own purposes. The general art teacher had less experience as a user of computer graphics but she had learned to use the tools and was able to model techniques and support her students in their own learning process.

The graphics tools used by the teachers and students during this study were clearly emancipatory as opposed to instructional, revelatory or conjectural (MacDonald, Atkin, Jenkins and Kemmis, 1977). They were labor saving devices. They saved time that would otherwise be spent learning to make graphic arts by trial and error. This is not to

say that the essential trial and error learning process was changed by the use of computer graphics tools. Rather that the time required to correct errors or replicate error free effort was dramatically reduced. The result of this savings in time was to empower the students and allow them freedom to create visual expressions of some sophistication and complexity.

In terms of the UNCAL typology of learner/CAL interactions (Kemmis, Atkin, & Wright, 1977), graphics production tasks are more like the "Constructive Understanding" demonstrated when students use higher order computer tools to create unique environments or symbolize new knowledge. In terms of the typology suggested by Kemmis, et. al., this is the highest level of interaction or transaction possible between a human being and any technology system. The open ended design characteristics of these computer graphics programs makes them powerful and non-trivial tools for extending the capacity of students and teachers into the realm of self expression and creativity.

<div align="center">Curricular and Disciplinary Sources of Lesson Materials</div>

The concept of *lesson materials* for computer aided learning in fine and vocational art education requires some definition. In traditional fine arts education, the lessons consist of learning techniques that the student artist uses to create art using a variety of media and materials. These techniques are learned primarily by demonstration and modeling.

Beneath the "learning how" there is also a strong tradition for "learning what", or learning about the historical precedents for techniques and their application. In contemporary *discipline based art education* learning about art history and the aesthetic foundations of the visual arts have been elevated to a status nearly equal in importance to learning techniques and using them to make student art.

Vocationally oriented graphic arts retains much of the emphasis on technique that we find in traditional fine arts education, but the emphasis on the product is changed. Vocationally oriented graphic art is oriented more toward production of a highly polished and professional looking graphic product for a purpose to be defined by another person.

Tasks are developed and assigned by the teacher as a surrogate employer. The particulars of any given assignment may be defined in either a very precise or a very ambiguous manner. Both types of assignments will probably be used in class because the vocational graphic artist should be able to respond to either literal and vague suggestions or hints about what is wanted by a potential client.

The assignments or lessons developed by the teachers and project support staff for use with the fine arts and vocational arts students were consistent with the regular non-computer lesson materials used in the same classes. In the traditional fine arts classes, the teacher set up problem definitions that gave direction to student art projects. In one class, the students were charged with creating elaborate Egyptian motif decorations for a school production or "show". In another class the students were given an assignment that required them to analyze the work of a selected traditional artist and create a derivative art work that emulated some of the significant formal or style elements attributable to the artist studied.

In the vocational art classes, the teacher set up assignments or tasks for the students based on her personal knowledge of work place expectations and the anticipated dynamics of client-artisan negotiations. It was important to the vocational teacher that the students also learn management and negotiation skills so that they could succeed at the business end of the trade as well as produce good graphic art. Art production tasks included advertising layouts, catalogue copy, book cover designs, and a variety of other realistic assignments. However, the problem solving or application dimension of the vocational projects was distinct and unlike similar projects in fine arts.

In last analysis, both fine arts and vocational arts teachers made only minor changes in the structure or content of the assignments given to their students on or off the ICON computers. The fine art teacher emphasized the discipline-based approach in her assignments and the vocational art teacher emphasized the application or problem solving dimension in hers. For both teachers it was necessary to spend some extra time helping the students learn how to use the computer graphic tools.

The real lessons came when the students mastered basic manipulative techniques and began to **use** the traditional or computer-based techniques to produce fine or applied art within appropriate task structures. According to John Dewey:

> When artistic objects are separated from both conditions of origin and operation in existence, a wall is built around them that renders almost opaque their general significance with which aesthetic theory deals. (Dewey, 1934, p. 3)

Pedagogical Characteristics of Art Education

The pedagogy of art education is exemplified by the activity of the two art teachers observed during this study. The teacher first plans a task structure or art project for the student. Then, they communicate the assignment to the student and define or demonstrate any new techniques or methods necessary to follow the task structure. Another aspect of communicating the assignment is that the student is often shown examples of art having the formal qualities that the teacher wishes the student to emulate in his or her own work.

Once the techniques are demonstrated and the task structure is communicated to the student artist, the teaching stops and the learning begins. Now the teacher shifts role and becomes a mentor or facilitator. In an art studio setting, the teacher *circulates* among the students who are engaged in working on their individual projects. The teacher answers questions, makes supportive comments regarding the students' individual work, and occasionally stops to trouble shoot or remediate if visible evidence indicates a technical flaw or some miscommunication of the assignment .

The whole time that the teacher is circulating and distributing his or her attention among all the students in the group they are also scanning the group. Good studio management requires that the teacher to be able to respond to the routine and occasional non-routine situations that are associated with a "hands-on" setting. Students

occasionally get side-tracked and must be directed back onto their assigned tasks. Materials get spilled and messes need to be cleaned up. Students can't find a critical material and can not continue with their project until the teacher help locate the missing item.

   The most important aspect of this distributive circulation and scanning behavior is that the teacher continuously interacts with the students. Anthropologist Dan McLaughlin suggests that teachers can operate in a reciprocal-interactive mode whereby students are active participants in their education or students can be passive and uninvolved as they listen to the teacher lecture (McLaughlin, 1990). In these art classrooms, the teachers comment, but also listen to what the students have to say. The students asks for help and the teachers either respond immediately or cue the required response behind other tasks having immediate priority. In either case, the teachers lets the students know that their request is received and that help is on the way. Interactivity and the judicious distribution of positive attention seem to be the keys to maintaining a good studio or computer lab environment.

   The description given here of activity sequencing and standard teacher behavior in art classes was also typical when both teachers were monitoring and assisting students doing computer graphics assignments. It made apparently little difference whether the students used a traditional art medium or a microcomputer workstation. The teachers behaved in a manner that was totally consistent with the ways that I have seen art teachers operate throughout my teaching career. From these observations, and from what the teachers said in their interviews, I conclude that their approach to teaching with the computers is probably influenced by their pedagogical training and background in art education.

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Hardware and Site Logistics
and
Access to Hardware

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   One of the most significant findings that this research may contribute to our broader understanding of CAL and the curricular integration of microcomputer technology may relate to the two contrasting hardware configurations that were designed into the two cooperating schools. A distributive ICON network was installed in the comprehensive high school. This configuration placed three networked ICON workstations and a printer in each of the cooperating teacher's classrooms. In contrast, a centralized and "hardened" microcomputer installation having 20 networked workstations, two printers, and a ROBOTEL console (allowing one selected screen to be displayed at all the terminals) was installed in the vocational high school. These distinct hardware installations probably influenced the teachers to operate differently in the two settings.

   In the fine arts classes, individual students were chosen by the teacher at the beginning of a newly assigned art project and given the opportunity to work with the graphics programs on the ICON computers. Assignments to the microcomputer workstations were being rotated through the entire class and eventually all the students would get an opportunity to do an art assignment on the ICON.

I observed that regular art projects generally took from a few days to a week for completion. Because all the art projects were self paced and some students were starting and finishing almost all of the time, students completing a computer art project were likely to be replaced by a new computer artist rather quickly. The turnover was continual and the flow of the class never seemed to shift to accommodate the ICONS in an intrusive manner.

In the vocational art classes, the students were accustomed to using the single available Macintosh workstation in way that was similar to the use of ICONS in the fine arts program. The major difference was that the students rotated on and off of the single workstation when their work required it rather than when the teacher directed it to occur.

The vocational art students were generally older and more experienced artists than the students in the fine arts program. The vocational art teacher generally gave them wide latitude to decide what tools they would use to execute any particular assignment. If they chose the Macintosh as a tool, then they waited for its availability in class or came in after school to use it.

When the vocational art class used the ICON laboratory it was a different story all together. First, the ICON lab had to be scheduled for the vocational art class. Then the lesson had to be planned and the class notified about the date and time that they would be going to use the lab. During a period where a new computer graphics tool would be introduced (i.e. IPAINT II), all the students would be able to see the teachers initial demonstration and use a workstation individually to try using the features of the program. In one sense this was an efficient learning situation. In another sense, use of the ICON lab was intrusive and represented a marked departure in the way that the class was normally conducted.

In short, the pacing of the learning events in the ICON lab was more teacher directed and less responsive to individual variation in skills, background, and learning style. This was mediated somewhat by the vocational art teacher whose personal style and approach to instruction was highly individualized.

One of the ways that a difference between a teacher-centered or student-centered classroom focus could be identified in the ICON lab was the student's reaction to engaging the ROBOTEL. When the teacher or instructor grabbed the students' video screens with ROBOTEL for a demonstration, there was an audible **snap...** followed by a sigh as everyone realized that control over their individual workstations had been lost. Often the teacher asked students in the class to demonstrate the computer graphics techniques using ROBOTEL. Control was always returned to students after the demonstrations ended. But the temporary loss of control over the resource still had a pronounced effect on student engagement and productivity.

Overall, the distributive network site was less intrusive on the classroom routine of the teacher and students than was the case in the centralized ICON site. Visits to the ICON lab seemingly altered the flow of work and the established routine in the vocational art classes. In contrast, placement of ICON workstations in the fine arts studio had no

pronounced effect on the work patterns or verbal interaction patterns in the studio setting. There were possible gains in instructional efficiency associated with having a larger number of microcomputers in one place. This was accompanied by a loss in individual task focus and productivity when the ROBOTEL was engaged for group-mode instruction.

Both scenarios had apparent assets and deficiencies. The longitudinal study undertaken as part of the RUCCUS project should eventually produce some substantial data on the instructional outcomes of choosing either a distributive or a centralized network arrangement. Either arrangement may be more appropriate in a specific setting or application. Hardware configurations should be set up to with full knowledge of the options and due attention to local needs.

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The Effects of Specialized Training on
Teacher and Student Use of New Technologies

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One of my most significant insights from this case study is that there appears to be an optimal approach common to training both teachers and students to use interactive technology. This approach appears to be based on two primary instructional practices: 1.demonstrating or modeling the appropriate techniques, and 2. letting the students use the techniques under the vigilant support of an experienced and sensitive teacher. As a former music teacher, this should be no surprise at all. Even so, when I realized that *circulating behavior* was a significant attribute in the teaching practice of Peder Nielsen and both of the art teachers , I thought that I was on to something.

The question is, where did this behavior come from? Since both art teachers in the study exhibited this as a dominant classroom behavior (with and without the computer being present as a student tool), it seems naive to conclude that both art teachers learned the circulating behavior from their in-service mentor Peder Nielsen. Is this highly individualized instructional behavior a shared pedagogical assumption in physics and also in art education? Or, is it good common sense to assume that self pacing, individualized instruction is a highly effective way to go about the business of teaching regardless of the subject matter or instructional medium?

One of the devices that Peder Nielsen used in his in-service training classes with the teachers from both schools was the introduction of sample cases wherein some instructional application would be made of a software tool from the ICON tool and courseware library. The particular software application might be an example of word processing in writing classes or spreadsheet use in social or natural sciences. Peder was very balanced in his approach to demonstrating the use of microcomputer tools in a variety of curricular contexts, but he showed an affinity for the use of tools rather than for drill and practice oriented computer assisted instruction.

The in retrospect, it seems that the most important attribute of these demonstrations may be that they were in fact based on contextually embedded cases about the curricular integration of microcomputer technology. There was usually a skill learning component involved in his teaching cases. Certainly, to use a new instructional technology

effectively with students, one must know what button to push... but his instruction didn't stop there.

It was common for the teachers in the classes to digress and discuss instructional and logistic issues related to their own intended or projected use of the software tool. They asked Peder's opinion and engaged him in brainstorming and troubleshooting with hypothetical scenarios that they might encounter in their schools. It wasn't until recently that I realized I was watching an application of case method instruction to the transfer of technology. Case pedagogy has been an accepted method of instruction in law, diagnostic medicine, management, economics, technology, and a variety of other discipline bases for many years.In a paper by Dr. Margaret Boos from the University of Konstanz in West Germany entitled "A Typology of Case Studies" (Boos, 1990), we find the following description of case method as a teaching tool:.

> As a means for education and training, cases are mostly used by jurists or economists. With a case, different ways of applying existing laws or theoretical models to real life events can be demonstrated. Management programs of numerous American business schools and universities are characterized by a strong emphasis on case method teaching in the tradition of the Harvard Business School. The advantage of this teaching method consists in the fact that theoretical concepts and methods can be introduced in a problem oriented way. Abstract facts are mediated in a way retaining the complexity, interdependency and uncertainty of empirical reality.
> (Boos, 1990, p.3)

The line of research followed by this study used observation, interviews, and collection of trace documents, work samples, evaluation forms and other incidental artifacts. The theoretical and organizational model for the study presented here is the case study (Stake, 1988). Given this model as an organizational framework for the inquiry, unique constraints and field conditions effecting naturalistic inquiry tended to make subtle changes in procedures and evolve methodology in much the same way that foreshadowed questions are evolved by subsequent iterations of research and reflection.

Within the framework of this case study, adequate and valid interpretation of the observed events in terms of participant's viewpoints and knowledge structures has emerged as a significant issue. Recently, House, Mathison and McTaggart (1989) have suggested that in educational research the concept of **validity** should be expanded to include "...inferences that practitioners draw from their own experiences...". They go on to suggest that :

> "...practitioners often cannot state what they know in propositional form. Nonetheless, it is the validity of their causal knowledge that is critical for professional practices like teaching." (pp. 15).

One of the most important insights gained from the teachers and students observed during this study is that microcomputers were apparently little more than an alternative medium or tool to support the students activities. The microcomputers were **no big deal**.

With or without them the business of producing student art projects continued in a traditional and predictable manner. Considering the special status we often associate with new technologies in our culture, the view expressed by these teacher practitioners that microcomputers are "...just another medium..." seems to indicate a shift away from more elitist attitudes about technology.

The validity of this discrepant view on microcomputers in curriculum has important implications for guiding the effective integration and use of microcomputers in the schools. Should educators let technology specialists guide the integration and use of microcomputers in the schools or should we listen to our own voices? Will the skills necessary to manipulate and creatively apply interactive technologies be limited to a technological elite in society or will microcomputers become tools for application toward a general increase in the efficiency and general productivity of the society at large?

This particular case study of ICON microcomputers in art education may not answer these questions but due consideration of inferences based on teacher's unique initial experiences integrating microcomputers in curriculum may have the same effect. In describing the qualities that distinguish case studies from other educational research, Bob Stake offers the following:

> In my own writing I sometimes talk about "naturalistic generalization." I think of this "way of knowing" as very important , for researchers and for others. We all, of course, also arrive at understandings through experimentation and induction, through what is commonly called "scientific generalization." It is not terribly important to decide which is more important. There are ample needs for both modes of acquired understanding.
>
> Most case studies contribute more to naturalistic generalization than to scientific generalization. But however they are useful, I believe they are more useful when careful thought is given to the boundaries of the case, the issues, and the patterns that illustrate the issues.
> (Stake 1988, pp. 260)

In the situation examined here, method should not be considered as an issue apart from the author's intention to illuminate the issues, case , and the patterns of events critical for understanding this particular application of microcomputers to curriculum. While it is a case about the integration and initial use of ICON microcomputers in two Canadian secondary art education programs, it is really a story of people learning to use interactive technologies in support of teaching and learning.

It is the author's intention that this case should illuminate the *causal knowledge* that the participating teachers drew about initial integration of microcomputers with art education and make that knowledge accessible for consideration by other educational practitioners. Although some events in these art classes may not have obvious relevance for developing technology integration strategies in other disciplines, important lessons have been learned.

. We hope that by telling the story, we will provide support and encouragement to applications developers, educational planners, teacher educators and other instructional personnel who are working toward achieving integration of microcomputers in the K-12 curriculum. A fitting application of the information gained from this research might be the creation of case materials for use in training teachers to meaningfully integrate microcomputers into curriculum. There is a great deal of work waiting to be done. I hope that we are up to the challenge.

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NOTES

[1]The single class that was observed <u>not</u> to use the ICON microcomputers was a low ability group. The teacher was initially reluctant to supervise the use of microcomputers with students she considered less reliable than her regular classes.

[2]Note that the idea of distributive networks and distributive pedagogy has major implications for nearly all the foreshadowed issues issues carried into the study from earlier research. More will be said about this in the conclusion.

[3]Parental permission forms were secured by the RUCCUS project staff before conducting student interviews. Semi-structured interviews were used to permit comparative treatment of the responses. Interview items were developed by the researcher to learn about: 1. students prior experience with art and with microcomputers, 2. what assigned work they did on the ICONs 3. technical difficulties they encountered using the ICONs, 4. what particular ICON programs they used, 5. what value they attributed to using the microcomputers in art classes, 6. what costs they attributed to using the microcomputers, and 7. what they might change to create an ideal situation for computer use in an art classroom.