MICROCOMPUTERS AS CREATIVE MEDIA IN FINE ARTS EDUCATION

By

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ABSTRACT

Microcomputer applications to fine arts areas of education have received limited attention although the need for interdisciplinary education made evident in a substantial body of literature would seem to make such applications desirable. The use of microcomputers as creative media for the composition of poetry, art images, and music by grade four students at an elementary school in British Columbia, Canada was observed and analyzed in order to discern what actually happened as a result of the juxtaposition of microcomputers and creative aspects of fine arts. Ethnographic research methodology allowed the classroom teacher to conduct the study in a participant-observer role throughout the 1988-1989 school year.

As a side aspect to the study, it was observed that students developed problem solving strategies that involved assessments and value judgements which encouraged those students to accept responsibility for their own learning.

Word processed poetry engendered visual awareness that promoted extensive editing and proofreading and stimulated exploration of visual presentations in the genre of concrete poetry.

Art images of nonrepresentational and abstract styles predominated because microcomputer capabilities supported such compositions and allowed students to experience satisfaction in their work regardless of their personally perceived proclivities toward portrayal in realistic style. The use of microcomputers facilitated image processing: the explorations of single ideas that resulted in the creation of series of related images.

The students revealed developmental stages in music composition approaches and perceptions by the manner in which they structured sound into music.

The students integrated concepts and techniques that involved poetry, art, and music into single works and thus demonstrated associative thought processing skills.

Microcomputers used as creative media in the fine arts areas of poetry, art, and music enabled unique learning outcomes, provided a previously unavailable means whereby the developmental stages of child music composition were able to be observed, and constantly allowed students to be simultaneously creators and observers of their own work. The students were thus in position to concurrently recognize and respond to artistic form: a position in which aesthetic experiences are possible.

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CHAPTER 1

STATEMENT OF PROBLEM

Introduction

The combination of microcomputers and fine arts is an integration of machine technology and the disciplines that are associated with human expressiveness. The need for such an integration of disciplines and subject areas in education is evident because of the increasing number of educational aspects that school systems are being expected to address.

The school system of British Columbia has been challenged in recent years by diverse expectations in regard to its educational purpose. Society has perceived as necesssary, and demanded that emphasis be placed on, subjects and topics that span all possible curriculum orientations. Each orientation originates in an ideology that is based on distinctive values, premises, and principles (Eisner, 1985). The schools have been pressured to maintain their long standing function of knowledge dissemination and graded testing, but also expected to concentrate on and develop students' cognitive processes. At the same time, the school system has accepted an increasing responsibility for students' social adaptation in such diverse areas as physical and mental health, environmental matters, and vocational training. The expectation that the education provided be personally relevant and meaningful to each individual in a complex and multicultural society has further confounded the role of the schools. Today's society appears to deem necessary the range of educational possibilities. Such expectations have resulted in fragmentation, confusion, conflict, and seemingly overburdened curricula.

Reassessment of the education system is resulting in gradual change. The acquisition of knowledge and memorization of facts are being recognized as futile and unprofitable in a society that daily generates vast amounts of knowledge, but one that also has the means to store and retrieve large masses of data. There is a realization that the schools need to provide opportunities for students to use and strengthen their cognitive processes. Development of skills in creative thinking, critical thinking, and problem solving are considered to be a foundation that will enable a student to learn any subject matter and to possess the flexibility to adapt to continuing rapid changes in society. Research has provided a greater awareness of the manner in which children learn and the developmental stages in their thinking processes. There is a growing realization that

previously separate disciplines can no longer be viewed in isolation. Learning from many different areas is required for the completion of any practical undertaking. Various disciplines are interrelated and dependent on others. The process of learning is the same for all disciplines because it involves assimilation of new understandings into a framework that has been constructed by the learner from previous interactions with the environment (Piaget, 1953). There is the need for children to amass a large amount of raw sensory data before they can assess and make sense of it (Holt, 1983).

An approach termed *holistic education* offers a possible solution to the dilemma concerning appropriate school curricula. The focus of holistic education is on relationships. Holistic education facilitates a broadening of vision and perspective by examining the relationships between mind and body, linear thinking and intuition, the individual and the community, and between various domains of knowledge (Miller, 1988).

The movement toward an interrelated holistic approach to curricula is evident in the British Columbia report of the Royal Commission on Education (1988), *A Legacy for Learners,* in which a common curriculum from kindergarten to grade ten is proposed. The *Language Arts Curriculum Draft* presented by the Province of British Columbia Ministry of Education (1989) strengthens and supports a movement toward holistic education because it provides the basis for integration of previously separate disciplines in the fine arts, sciences, humanities, and practical arts. This proposed curriculum recognizes that viewing and representing are aspects of language communication in addition to the traditional strands of speaking, writing, reading, and listening. Such a broad based view of communication enables and requires learning to be approached in a holistic manner.

Much of the prevailing thought regarding school curricula and educational practices appears influenced by the philosophy of the Russian psychologist Vygotsky (1978) who believes that learning activates developmental processes when a child is interacting with and relating to the environment.

There exists a present need for teachers to acknowledge and examine the total range of learning resources available, to accept the fact that many different areas of learning contribute to any one meaningful or practical experience, and to explore the possibilities and advantages of a unified holistic approach to the education of society's young.

The Research Problem

As a classroom teacher, I was personally affected by the demands that were being placed by society on the school systems. The curriculum continuously expanded to include diversified segments of learning such as consumer education, bicycle safety, and drama. Suggested methodological and organizational approaches to assist teachers to cope with and alleviate the burden of the distended curriculum originated in conflicting philosophies. None addressed the overall problem of defining the purpose of schools in relationship to the needs of society and the present extent of knowledge of the manner in which learning occurs.

As a result of years of experience as a teacher of general subjects to students aged three to thirteen, I had evolved a personal understanding of the interrelatedness of all disciplines and a belief that the fine arts are basic to education. The internal structure of the school where I was employed afforded me the opportunity to specialize in fine arts areas. I was able to teach the major portion of an eight year sequential music program that I developed for the school, and to provide direction and resources to the teachers who instructed the earlier levels. Responsibility for language and mathematics instruction to a grade four homeroom permitted me to explore and use teaching strategies that integrated music, art, drama, dance, and poetry. For many years I could imagine no practical or important classroom application for the few computers that were housed in the school library.

Although funding for educational pursuits had been severely restricted in the province of British Columbia for several years, most elementary schools were equipped with a small number of microcomputers. No actual use had been designated for these computers. Diverse applications such as simple programming, basic math fact drills, and word processing had been developed by individual teachers according to their own interests and expertise and the availability of equipment. Students were often permitted to play arcade type games on the computers possibly in the hope that such activity would satisfy the vague requirement for computer literacy that had been added to the overflowing curriculum.

The announcement that a large proportion of educational funding was about to be made available to improve and increase computer use in the schools seemed anomalous given the lack of application such equipment had found in elementary schools. Computers were being used for business and other vocational training courses in secondary schools where they were certainly viewed as basic necessary equipment. However, this piece of equipment seemed to possess unique characteristics that had not been fully explored for

other educational purposes. Research supported data to justify the infusion of funding into computers for school use was minimal. There appeared to be very little research in the field of computer use in the schools. Available research primarily addressed attitudes of students and teachers to the computer, but did not explore curriculum based applications for computers. There was an understandable lack of research into the use of computers in fine arts areas of education because such uses had received little attention.

I was personally aware of computer applications to the fine arts and realized that students, even if unknowingly, are often familiar with such applications. Computer generated images and sounds are commonplace on television, radio, and in movies. Television commercials and program titles, much popular music, and even full length movies such as *Tron* (Lisberger, 1982) provide examples of commercial computer applications to the fine arts. The computer as a creative medium had found acceptance and application in employment related areas and in the work of professional artists, writers, and composers. In these areas, the use of the computer as a creative medium was well established, and its inclusion as a creative medium in school fine arts appeared not only timely and desirable but possibly advantageous to the creative expression of students.

Young children had been observed to exhibit frustration in attempts to express themselves creatively. The outcomes that these chidren desired often required too much time, effort, and not yet acquired skill for their successful accomplishment. It seemed possible that inherent creative capabilities of young students seldom achieved full expression because the students were restricted by their lack of technical skills, mastery of materials, and limited concentration spans. The unique properties of a computer used as a creative medium implied removal of many of these restrictions. Music compositions could be played instantly on a wide range of instruments. Images that would require hours of work, or be impossible using any other medium, could be achieved in a few seconds. Reversible experimentation with colours and composition, and rapid changes to work in progress could be made. Perception of the visual impact of a poem was readily apparent. Proficiency in such physical and technical skills as control of a paint brush, or performance ability on a musical instrument need not limit or affect creativity. Children who worked with a creative medium that freed them from many former restraints could reveal insights into ways in which they created and learned.

A university course that introduced me to computer music and art provided the basic knowledge and enthusiasm that permitted me to introduce a computer as a creative medium to my grade four homeroom class

during the 1987-1988 school year. My approach was experimental, and the students were free to explore possibilities without any preconceived expectations as to finished products. The students displayed enthusiasm and interest as they created works of art, music, poetry, and prose using the computer as medium. As the children gained facility with the programs, I became aware of many interesting and thought provoking outcomes. The children appeared to be discovering, learning, and using concepts at a much faster pace than would normally be taught. Image compositions quickly progressed to use of complicated overlapping elements, music compositions were more concerned with vertical, multitimbre structure than with linear melodic lines, and word processed prose and poetry seemed to engender greater awareness of visual presentation.

Juxtaposition of the technological and the aesthetic had proved interesting and had created an awareness that much could probably be learned regarding the creative thought processes and development stages of children through close observation and analysis of students' use of computers as creative media. The topic related directly to the move toward interdisciplinary education and an integrated curriculum but appeared to lack research. Could the use of computers as creative media promote learning outcomes in fine arts areas that were unattainable without use of such equipment ? What could be learned about children's creative development by observation of students using computers as their creative tools ?

Reflection on the questions suggested several foreshadowed problems that would provide direction for a research study. These were (a) the use of other media to preplan work that was produced at a computer; (b) the extent and nature of the changes and revisions that would be made to work in progress; (c) the emphasis that would be afforded the elements of rhythm, melody, form, harmony, dynamics, tempo, and timbre employed in music composition; (d) the extent to which the immediate playback performance capability of the computer would be used during composition of music; (e) the emphasis that would be afforded the elements of line, shape, form, texture, colour, tone, and intensity in the creation of images; (f) the consideration that would be afforded the design principles of balance, contrast, emphasis, movement, pattern, and unity in the creation of images; and (g) the attention that would be given to the visual aspects of poetry to enhance the poetic elements of unity, vocabulary, imagery, rhythm, and affective quality.

The focus for this research was the observation and analysis of what actually occurred when grade four students used computers as the media that enabled their creative self-expression in the fine arts areas of music, art, and poetry.

The Role of the Teacher-Researcher

The problems addressed in this study necessitated that the investigation be undertaken by the teacher who was exploring the possibilities for use of computers in fine arts areas of education. The study of a situation as it existed and developed in order to interpret what took place demanded the gathering of qualitative data by a researcher who was both a participant and an observer in relation to the phenomenon under study. Ethnographic research methods were obviously required.

Ethnography is well established as an approach to educational research. Originating in the science of anthropology as a method for the study of social cultures, ethnography has proved a valuable method for the study of the microsocieties of school systems, schools, and classrooms. The field research strategies involved often prove more useful than traditional experimental measurements in generating data appropriate for solving problems or answering questions that pertain to education.

Many studies in areas of English language learning support the value of ethnographic research. The ethnographic study by Graves (1980) of the writing processes of children led to many related studies. Calkins (1983), and Florio and Clark (1982) explored different aspects of how and why children write. Insights gained from these and other studies have resulted in changes in the manner in which teachers approach the task of children's writing. The process approach to writing that is now used in most elementary schools was developed as a result of research designed to discover how children actually attempted and performed writing tasks.

Music education is another area that has been suggested as suitable for an ethnographic research approach because the strategies involved allow the researcher as a participant to obtain firsthand knowledge of the problem under investigation. Explanations of what actually happens can then be drawn from the data itself rather than from structured, preconceived techniques established for quantitative measurement (Krueger, 1987). A panel discussion at the American Orff Schulwerk Association Conference in 1988 revealed strong support for ethnographic research undertaken by classroom teachers. The idea was advanced that a study of the questions whose answers are most urgently needed by teachers can best be achieved by providing interested teachers the time, space, and encouragement to become researchers (Bohlmeyer, 1989).

The study of arts and aesthetic education have proved elusive areas of inquiry in the past for the possible reason that a researcher in arts education must attempt to understand the meaning of events and explain them to others (Courtney, 1987). An experienced teacher who works with a class of students throughout a school year

would appear to be in the ideal position to develop sufficient depth of understanding of both students and classroom events to enable some useful explanations of observed events to be offered.

The role of researcher as both participant and observer is one that naturally suits a classroom teacher. Teachers learn to observe and interpret a wide range of classroom events as a natural and necessary component of their work, and thus develop many skills that are characteristic of anthropological researchers (Strahan, 1983). Experienced teachers are potentially strong researchers because of their knowledge of children and classroom settings (Kantor, Kirby & Goetz, 1981). Sitton (1980) provided the thought which described my situation aptly. He claimed that "in the approach to children as cultural informants, and in the quest for particulars of children's culture, the teacher is her own best ethnographer. The teacher *has* to be" (p. 545).

Definition of Terms

Several terms used in the report of this study are either general in nature or have specific meaning in the context of classroom teaching and methodology. Definitions of these terms as used in this report are therefore offered for the purpose of clarification.

Computers. The computers referred to in this study are accurately termed microcomputers but are also popularly known as personal computers.

Fine arts. The fine arts are considered to comprise music, art, drama, dance, and poetry.

Creative media. Creative media are modes of artistic expression or communication. A computer is viewed as a creative medium because it can be both the tool that is used creatively and the means of expression of creativity in much the same way that a brush, trumpet, or pencil can be the tool that expresses creativity in the production of a painting, a melody, or a story.

Grade four students. Students who are in grade four are usually nine or ten years of age.

Keyboarding. The term keyboarding when used in conjunction with computers refers to one means of putting data into computer memory. When used for word processing, keyboarding is equivalent to typing on a typewriter and requires similar skills.

Word processing. Word processing is the means by which printed documents are developed when a computer is used in their production. It involves keyboarding; manipulation of the text displayed on the monitor for purposes of editing, proof reading, and formatting; use of a disk to store and retrieve work in progress; and

use of a printer which is connected to a computer.

Writing Process. The writing process is a format used to develop students' creative and practical writing in a manner that was shown by research to be natural and meaningful to children. The process places responsibility for the quality of the finished product on the student and involves the following steps:

1. Prewriting provides motivation and writing purpose and identifies the audience for the finished written work. A wide range of activities are able to be employed in this initial step.

2. Draft writing is the capture of thoughts and ideas in written form with little concern for correct spelling, punctuation, or other formalities.

3. Editing is usually done in peer groups and is the stage where each child ensures that the writing conveys the intended message and makes use of the most effective vocabulary and form of expression.

4. Proofreading is usually assisted by peers or teacher and is concerned with correcting mistakes in spelling, punctuation, and other formal aspects of language.

5. Publishing of the written work is accomplished in a manner suited to the material with attention directed to the format and legibility.

6. Presentation of the published work is made to its intended audience.

Summary of Problem

In order to study the phenomenon of computers incorporated as creative media in a grade four classroom, an ethnographic approach to research was required. The situation in which students were enabled to create visual images, music, and poetry by use of computer was observed as it evolved in the naturalistic setting of a classroom where I was both the teacher and the researcher. The focus for the study was integrated and interwoven with regular classroom work as I instructed the students in curricula prescribed by the British Columbia Ministry of Education.

I anticipated that some conclusions might be drawn regarding the effectiveness of computer use to the creative expression of grade four students and that developmental stages in the creative processes of children might be revealed and observed because the computer as a creative medium would enable access to many previously unexplored possibilities for expression.

CHAPTER 2

LITERATURE REVIEW

Overview

The interdisciplinary nature of a research problem that focuses on computers used as creative media in the fine arts requires a broad base of reviewed literature. The nature of the problem places it within the province of the relationship-focused holistic approach to education. The holistic approach is rooted in the curriculum orientation position of transformation which concentrates on personal and social change (Miller, 1988). Miller explains that the holistic approach is inclusive of the transmission position which imparts preselected values, skills, and knowledge, and of the transaction position which stresses the development of cognitive processes directed toward problem solving. In holistic education, transmitted knowledge is applied to the solution of problems. The problem solving is incorporated within a context that facilitates a broadening of vision and perspective. Holistic education therefore encompasses all three curriculum orientations.

The background for this research includes literature that pertains to computers, the fine arts, and computers related to various facets of the fine arts. Most of the literature is directly related to education; some in the fine arts areas is of a more general philosophical nature. Within each major category may be found literature that expresses philosophies or opinions, describes instructional methodologies and strategies, or reports researched results of both measured learning and of how learning occurs. Transmission, transaction, and transformation orientations toward curricula are represented in the literature reviewed.

Fine Arts in Education

The need for fine arts education is well recognized and established in most education systems. The Report of the Royal Commission on Education (1988) in British Columbia stated that "the arts are necessary for all students because of the contributions they make to the fulfillment of every individual" (p. 97). The philosophy statement in the Province of British Columbia, Ministry of Education, *Elementary Fine Arts Curriculum Guide/Resource Book 1985* recognizes that education in the fine arts "is an essential part of the development of every child in that it provides a unique mode of experience that stimulates creative and intuitive

thought while developing the intellect" (p. 3). The fine arts are indeed unique in their capability to provide learning outcomes in all aspects of education: cognitive, affective, and psychomotor. However, between the intellectual cognitive domain and the emotional affective domain lies a third territory, "the aesthetic aspect of experience" (Broudy, 1977, p. 1). The aesthetic element embodied in the fine arts makes study in such areas important.

Education in the arts is concerned with the education of feelings. Langer (1957) defines all art as "the creation of perceptible forms expressive of human feeling" (p. 80) and explains how aesthetic experiences are possible in fine arts education. Students are simultaneously participants and observers, creators and perceivers of what is created. Art is both the product and the instrument of human insight, and response to the expressive form that is created embodies an aesthetic experience (Langer, 1957). An artist knows when a work is satisfying or complete because that artist perceives it to be so (Dewey, 1934). The ultimate goal in fine arts education could perhaps be that of providing the opportunity for the simultaneous recognition of, and response to, artistic form: the constituent parts of an aesthetic experience.

Respected philosophers, researchers, and teachers have provided foundations for many currently accepted approaches to fine arts education. Many present day classroom practices in their approach, methodology, or strategy are rooted in philosophies that were developed through observation of the developmental stages of children. Stages of development were categorized by Inhelder and Piaget (1958) as the sensorimotor stage from birth to two years, the preoperational or representational stage from two to six years, the concrete operational stage from seven to eleven years, and the formal operational stage that followed. Examples of classroom practices that recognize such developmental stages in children are readily observable in elementary school music education.

The Hungarian composer Zoltan Kodaly became interested in music education in the schools and worked with teachers and students in an attempt to develop universal musical literacy in his country. Kodaly believed that singing was the foundation for musical literacy. His efforts to develop such literacy led to a music education approach that began in nursery school (Choksy, 1982). The sequence for instruction is a child-developmental one as opposed to one based on subject logic. The arrangement of the subject matter follows normal child abilities at various stages of growth (Choksy, 1974).

The basic ideas of Kodaly were first introduced into North America by Richards in the 1960s. Realizing

that the sequencing of what had become known as the Kodaly Method was not consistent with the rhythm and melodic patterns of English language songs, Richards adapted the basic principles of Kodaly and developed an approach termed Education Through Music (ETM). The approach that evolved raised a question concerning the point at which an adaptation becomes independent and loses connection with the original method's purpose (Bennett, 1987). Development of the whole child is important to Richards (1977, 1978). She emphasizes the provision of opportunities for children to experience the aesthetic through the wholeness of an initial experience before the parts of that experience are studied in relationship to the whole.

Another major influence in present day approaches to music education is that of the German composer Carl Orff. The Orff-Schulwerk approach concentrates on creativity and improvisation. It strongly integrates speech, movement, dance, and drama (Matthesius, 1977). The concept of continual participation in music making by all students led Orff to design or adapt instruments to facilitate such participation by students of diverse levels of ability (Frazee, 1987).

The philosophies of both Kodaly and Orff have been adapted and developed for use in many countries including Canada. Kodaly and Orff presented their concepts of music education so strongly that teachers were willing to find the ways, methods, sequences, and structures to achieve those concepts. The musical literacy and enjoyment demonstrated by students who have experienced Orff, Kodaly, or ETM music programs suffice to maintain these methodologies as important influences in elementary music education.

Secondary school music education tends to emphasize performance practices. Band classes in particular may work from content-sequenced method books that disregard any previous musical learning that a student may have acquired. Turpin (1986) suggests that existing secondary music methods could be strengthened by application of the methods which have proved so effective at elementary levels.

Research studies in music education areas are plentiful but often concentrate on isolated details out of context. An example is the study in which students who had received no previous music education were tested to ascertain whether visual or aural presentation of rhythms better facilitated learning and retention (Shehan, 1987). Variables that influence music preferences have also been explored. The effects of vocal vibrato and performer's sex (LeBlanc & Sherrill, 1986), exposure to classical music (Peery & Peery, 1986), music appreciation courses (Price, 1988), and tempo (LeBlanc, Colman, McCrary, Sherrill, & Malin, 1988) have all been found to contribute to preference. Research that is concerned with either the Orff or the Kodaly approach

used in English speaking countries is not readily available. No study has as yet been undertaken to investigate the effectiveness of the ETM approach to music education (Bennett, 1987).

Dance education has been influenced by what began as a reform of music instruction in the early 1900s by music teacher, Emile Jaques-Dalcroze (Mead, 1986). His study of music through movement, which he termed *eurhythmics*, showed how the age-old association of movement and sound could be used to develop aural perception in children (Findlay, 1971). Jaques-Dalcroze (1930/1980) recognized rhythm as the natural force that established the sight-sound relationships between different arts such as music and poetry, poetry and art, and art and science. He believed that the natural, instinctive rhythms of children should be utilized to develop their intellectual and physical powers.

The majority of leadership and direction for drama education originated in England. Drama was viewed as a theatrical art until the 1950s when the work of Peter Slade drew attention to the developmental drama stages of children. Slade (1954) considered natural child drama an art form in itself and the means through which a happy and balanced individual could develop. The focus for drama education became the personal development of the individual. Theatre activities were completely separated from the role of drama in education by Brian Way (1967) when he stressed that drama was practising one's own personal resources and using those resources in relation to one's environment.

The influence of Dorothy Heathcote and Gavin Bolton did much to direct drama to its present status of recognition as a unique teaching tool and a mode of learning in which the natural play and make-believe of children is used as a model in creating learning opportunities. Heathcote strove for understanding through feelings and yet required that children pursue knowledge through the aspects of creating and coping within a drama experience. She demanded that communication be clear and specific in both discussion of ideas and in dramatic expression (Johnson & O'Neill, 1984). Bolton (1979) recognized that learning potential in drama was not only in areas of skill development and objective knowledge but, more importantly, in the ability of a drama experience to involve a change of feelings in concepts concerning value judgements.

Drama explores relationships and, being a reflection of life, provides secure and supportive opportunities for children to test and grow in relationships. Creative rather than conventional responses to the environment are encouraged (Tarlington & Verriour, 1983). Drama is realized through language and thus can be used in other curriculum areas whenever desired objectives include the understanding of human experience, exploration

of attitudes and opinions, or concrete representation of abstract concepts. The topic or concept being taught is enlivened, and drama is provided with serious worthwhile content (O'Neill & Lambert, 1982).

Firm belief that drama ". . . must be at the centre of any form of education that aims to develop the essentially human characteristics" (Courtney, 1968, p. 259) seems to be sustaining the increasing acceptance of drama in education.

It was not until the beginning of the 20th century that children's art work was recognized as important and capable of demonstrating aesthetic expression. The work of European painter Franz Cizek is credited by Viola (1944) as that which led to reform in the conception of art education. Cizek believed in the creativity of children and their right to develop naturally. Fifty years spent in the study of the work of thousands of students in his own child-centred art school allowed Cizek to distinguish and describe the developmental stages of child art. Cizek observed that children produce what they know, not what they see, and adults need to approach a child's work from the perspective of how it appears and not ask for an explanation of what the child has produced.

Herbert Read (1956) made an important contribution to art education in his book *Education Through Art.* The major tenet of his book, that art should be the basis of all education, he claimed to have likewise been held by Plato. Read explains in detail, from psychological, aesthetic, and developmental positions, how art can be the basis of a fully integrated approach to education.

Victor Lowenfeld was actively engaged in the study of children's art work for many years. He places major emphasis on the function of art in a child's cognitive development and describes stages of art development as a progression toward realistic representation (Lowenfeld & Brittain, 1982). Similar developmental stages are described by Lansing (1976) who also explains the manner in which some images provide pleasurable experiences for viewers. The components of such images enable them to be evaluated as works of art as opposed to nonart.

Emphasis placed on progression toward realistic representation is considered by Rhoda Kellogg to repudiate aesthetic value in children's art. Kellogg (1970) believes that children should be permitted spontaneous art development. The resulting work should be accepted with no attempt at evaluation. She is strongly against the integration of art with other subject matter. Through detailed analyses of children's scribblings and drawings, Kellogg indicates that the basic line formations and motifs of child art are also found

in the art work of adults.

Guidelines for examining children's art are provided by Mattil and Marzan (1981) who comment that most authors concur on developmental stages in art although they may use different terminology. The generally accepted stages are (a) scribbling during which muscular coordination is developed, (b) the stage of consciously searching for a schema through which to express ideas, (c) the symbolic or schematic stage in which observation provides detailing of images, and (d) the stage of visualization or desire for representational realism.

Poetry is often considered in conjunction with language education although there are available numerous anthologies of poetry and many publications that describe methods and activities that address poetry composition. No generally accepted approach to poetry education is evident. The different strategies presented by different authors are often based in philosophical positions that conflict in purpose. The central issue of conflict appears to concern whether or not child poetry can provide its own aesthetic experience and thus be recognized in a manner similar to that in which child art is now recognized.

Does one accept that children's poems are about their own emotions, sensations, and experiences (McNeil, 1980) or require that they conform to the criterion that good poetry escapes from the world of private images to create an effective experience for others (Livingston, 1984) ? Must children's poetry exhibit disciplined imagination and translate personal images into universal symbols (Livingston, 1984), or may it be candid, energetic, surprising, refreshing, and charming (Collom, 1985) ?

Livingston (1984) strongly opposes the publication of children's poetry which, she explains, may lead children to believe that their poetry is on a par with the finest poets. Such publication is considered to flout the tradition of poetry as a crafted work. She calls for less attention to product and more to the process of working with traditional elements of poetry. The natural speech rhythms of children are considered unacceptable in a finished poem. In contrast, Collom (1985) respects the natural speech rhythms of children and the simple unfettered realism of their expression yet provides opportunities for students to experience and experiment with poetic devices.

Powell (1976) acknowledges that writing is a craft that demands skills which can be learned and proposes a wide range of models, forms, and formulae as structures for the composition of poetry (Powell, 1973, 1976). Poetry writing direction, approach, and purpose are further confused when visual-oriented concrete poetry is

considered. Colombo (1971) defines concrete poetry as a direct presentation that uses the semantic, visual, and phonetic elements of language as raw material. He claims that contemporary artists are showing possibilities for aesthetic pleasures in areas overlooked or unknown to traditional writers. McNeill (1980) includes the use of concrete poetry at all grade levels in her collection of creative ideas for teaching poetry.

Little research is available concerning poetry in education, but a study to determine what type of poetry was most enjoyed by upper elementary aged students revealed a preference for contemporary rather than traditional poems (Terry, 1972). No examples of concrete poetry were among the contemporary selections used in the study.

Many practical suggestions for interrelating, integrating, or combining facets of the fine arts are available to teachers. As an example, the use of poetry is an integral part of the Orff-Schulwerk approach to music education. In an article that described suggested lessons for music classes, Hamm (1989) explained that music is sound, and poetry may be deemed music when experienced through the ear.

Research studies that link fine arts areas are not readily available. Results of a study that explored the association of colour with music strongly supported the existence of such an association (Cutietta & Haggerty, 1987).

Closer integration of the fine arts is considered desirable as indicated by the combined elementary fine arts curriculum developed by the Province of British Columbia Ministry of Education (1985). This approach to curriculum raises questions concerning the ways in which fine arts areas of learning are interconnected.

Read (1956) claims that form is common to all works of art. Langer (1957) suggests that the arts are interrelated only in that they all create an expressive and a symbolic form. When integrated arts courses are taught, there is the problem of maintaining the integrity of each art form while at the same time exploring the commonalities that do exist (Rozmajzl, 1985). Students should have the opportunity to become aware of how each of the arts is unique (Wenner, 1970).

No finite answer to a question concerning the extent of relationships among the fine arts seems possible, although many present day film, video, and multimedia productions appear to be concerned with exploring and testing the relationships.

Integration of the Fine Arts, Sciences, and Humanities

In considering the wider integration of the arts into other subject areas, the concern arises that the uniqueness and comprehensiveness of knowledge in the arts may be diminished (Kindler, 1987). A different perspective is provided by Maslow (1971) who believes that the arts should be the basis for all education because they are so close to the human psychological and biological core.

There is already an inexorable mix of the humanities and computer controlled technologies, and it may be that education in the liberal arts will prove more useful in coping with increasing technological advances than will education in a narrow range of technical skills (Adams & Fuchs, 1985). No clear distinction has yet been made between the human talents or powers that are prerequisite for creative achievement in the sciences and those prerequisite for artistic achievement. Winchester (1985) considers that it is perhaps arbitrary whether capable individuals achieve in the arts or the sciences. Read (1956) views art as the representation and science the explanation of the same reality. Eisner (1987) explains that the arts are situated in a culture that affects the qualities that they possess, but the arts then affect the culture in which they are situated.

The apparent encroachment of technical studies into arts and sciences can be viewed as an opportunity for cultural exchange, and integration of the humanities and technical programs may be limited only by the imagination (Labin & Villella, 1986). An understanding of the principles that underlie the technology should assist the invention of new roles for the machines (Adams & Fuchs, 1985).

The questions that concern interdisciplinary learning and how effectively separate disciplines can be integrated in education are still mainly conjectural. Suggested units of work and lesson plans of an interdisciplinary nature have been published over a period of several years. Resource materials developed by Davies (1986) provide an example of an interdisciplinary approach to education in that they enable the music, instruments, art, and crafts of the Japanese people to be explored as a component of a social studies approach to Japan.

The whole language approach to teaching and learning at the elementary level is probably the most organized example of an attempt to integrate previously separate disciplines. Based on the constructionist theory propounded by Piaget (1953) who proposed that children learn by constructing meaning from stimuli received, whole language is a process of learning that emanates from a meaningful language experience to a study of the components of the whole experience. Language is considered the basic medium of learning

(Goodman, Smith, Meredith, & Goodman, 1987). All aspects of communication are integrated to enable new concepts to be presented in as many different ways as possible. Reading material must be meaningful literature as opposed to selections constructed with controlled vocabulary. Units of instruction are based on topics which are often treated thematically. The whole language approach is thus capable of addressing the teaching and learning of a diverse range of subjects in all disciplines. Research and evaluation of the effects of such integrated learning are still sparse.

Computers in Education

The development of the microcomputer resulted in computer technology becoming financially available to the general public. There was awareness that this latest technological advance promised to be of great importance to business and industry and would cause many changes in society. It therefore followed that the schools needed to become involved in some form of computer education. Thus, computers were first introduced into classrooms around 1975. No actual use was designated for the computers. Perhaps because of this fact, emphasis tended to be placed on learning about computers: how they worked and were programmed. Realization slowly came about that "a computer without an application is useful for little more than a paperweight" (Ragsdale, 1985, p. 26).

In 1980, Taylor introduced the terms *tutor*, *tool*, and *tutee* to categorize the three major uses of computers in education. Although Taylor warned that slavish use of such categories could divert attention from relevant insights, his proposed classification became generally and widely accepted.

As a tutor, the computer runs programmed software to drill, test, and evaluate knowledge acquisition of students in such areas as math facts, musical intervals, or world capitals. Use of the computer as a tutor is widespread because a majority of software developed for educational use is of the drill and practice variety.

As a tool, the computer is programmed to provide a service that will enable some task to be done more quickly or more efficiently than previously. Computer capabilities for word processing, data analyses, and mathematical calculations are examples of the computer used as a tool.

In the tutee mode, the computer is programmed, or taught to do something, by the student. Papert (1980) is a leading advocate in the use of the computer as a tutee. To provide children with a sense of mastery over the computer, Papert developed *Turtle Logo* which challenges children to program movements of a turtle icon on a

monitor screen and, by so doing, assimilate principles of geometry and physics. Papert claims that when children learn to use computers in a masterful way, their total approach to learning changes and becomes closer to Piaget's ideal of learning without being taught.

Extensive study of the development of children's thinking processes led Piaget to conclude that children construct meaning by observing and interacting with the environment. Children assimilate new information into their existing structures and extend their understanding in the process of accommodating new input (Piaget, 1953). Higher levels of formal, logical thinking must be preceded by stages of sensory experience, symbolic representation, and concrete operation of the environment (Labinowicz, 1980). Papert's *Turtle Logo* provides opportunity for children to progress through the developmental stages of thinking processes and learn by discovery and assimilation.

The pressure on schools to produce computer literate students gave rise to much questioning and debate as to what actually constituted computer literacy (Johnson, Anderson, Hansen, & Klassen, 1980; Luehrmann, 1981). Computer literacy was variously interpreted, but attempted definitions usually included experience with computer applications which were being used in the business world, knowledge of the history of the computer and how it worked, and use of the specialized vocabulary that had developed. The computer as a topic was thus added to Taylor's categories of tutor, tool, and tutee.

These generally accepted categories for computer use were employed to classify the computer's application to knowledge dissemination in a taxonomy for educational computing proposed by Knezek, Rachlin, and Scanell (1988). This taxonomy included the need to study the computer as a topic in view of its effects on society and the moral and ethical questions that were being posed by its increasing use.

Acceptance of the tutor, tool, tutee, and topic approaches to the use of computers in education is evident in the Province of British Columbia, Ministry of Education, K-7 Resource Guide 1984, *Computers Into the Classroom.* Goals are expressed as meeting needs in awareness, knowledge, operation, and future occupational and professional areas. The computer is seen as both a topic, itself a subject for study, and a medium for instruction. Suggested uses include problem solving through the development of programs by students; practical applications such as word processing, data bases, and spreadsheets; assistance to teachers in record keeping tasks, marking, and monitoring of student progress; and as a tutoring device in areas of drill and practice, simulations, and educational games.

Many of these applications, especially those in tutor mode, promote the impression that the computer is in control of the human. Turkle (1984) observed that the computer culture threatened the very idea of "self." Fear that computers may render many human endeavours, including teaching, redundant appears to be the basis of much literature related to computers in education.

No other piece of new classroom equipment has generated so much concerned research to gauge attitudes of students and teachers to its introduction. Chan (1987), MacLean (1988), Menis (1987), Smith (1986), and Vermette, Orr, and Hall (1986) all researched the attitude question and generally found that students had positive attitudes to computers, and teachers were less confident but accepting.

Possible changes in classroom interactions were researched by Diem (1986) who found that the computer seemed actually to support cooperative group socialization. Theories as to the possibilities of changed social interactions were advanced by Baker (1985), Bloomfield (1987), Johnson and Johnson (1986), and Steier (1987). Predictions ranged from severe isolation of the individual to extensive changes in teaching and learning styles to accommodate the advent of the computer in the classroom.

Among the plethora of critical analyses, theories, and predictions about computers in education was included the suggestion that educational computing was at risk of failure (Maddux & Cummings, 1986). Cause for possible failure was indicated to be the predominant application of computers to drill and practice activities and administrative tasks. It was claimed that success of computers in education would depend heavily on the ability of educators to find important rather than trivial goals to apply to their use. Demonstrated applications that provided new and better ways of learning, with emphasis on what children could be empowered to achieve, were needed to enable the effective and successful use of computers in education. Ragsdale (1983) also stressed the importance of developing appropriate applications for computers. He noted that the computer's capability to motivate students was misleading educators into believing that delivery of content via computer was an effective application even when that content was poorly presented.

Fears that educational computing could be facing failure were supported by the research of Pulos and Fisher (1986). Interviews were conducted with students from two schools where computer studies consisted of educational games, computer-assisted instruction, classes in computer literacy, and brief introductions to programming and word processing. Attitudes of the students toward computers were found to be poor, and understanding of computer applications was low. The computer use experienced by these students was not

considered by them to be relevant to school work or to their future careers.

The use of computers in general education remains largely unevaluated and lacking in any clear direction.

Computers in Fine Arts Education

Computer use in any subject area or field of learning has only been possible through the development of specific software. In the fine arts disciplines of music, art, drama, dance, and poetry, the majority of attention has been given to music.

As early as 1970, demonstration programs to assist college music education were being written. These developed into the many drill and practice programs prevalent in music education today. In 1981, Shrader claimed that the dream of high quality microcomputer-based music instruction for all students had become a reality. He was referring to instruction in ear-training, pitch recognition, and music theory. Such use demonstrates the capability of the computer as a tutor in Computer-Assisted Instruction (CAI).

Learning outcomes from drill and practice types of instruction can be suitably measured by empirical studies, and many such studies have been undertaken to assess the use of the computer as a tutor of music skills. Arenson (1984), Benward (1984), Deal (1985), Greenfield and Codding (1985), and Pembrook (1986) all found that CAI proved more effective than traditional methods in the teaching of fundamental music skills. The majority of this research has involved university undergraduate students.

In addition to the computer's use as a teaching machine in music education are its uses as a music synthesizer and as a management tool for storing student records, equipment inventories, and music library information (Rumery, 1985). The fact that creative applications for music instruction were particularly wanting was noted by Franklin in 1983. This is not the case today. Several software programs that allow manipulation of sounds and enable music composition are available in formats termed *user-friendly* because their operation is considered to be easily understood by users possessing no actual technical knowledge of computers. However, introduction of this software is so recent that very little literature exists that pertains to its use in education.

Information regarding the use of computer software for music composition is available in trade magazines where evaluations do not appear to be supported by research. For example, in an issue of *A+* magazine it is claimed that a certain music composition program has "editing features . . . as slick and convenient as those of anything else on the market" (McClain, 1988, p. 36).

Music education journals are publishing an increasing number of articles written by educators who are involved with computer music composition and performance. Considerable attention is being given to possibilities provided by the Musical Instrument Digital Interface (MIDI) standard interface system that was developed in 1983. This system enables electronic instruments, synthesizers, and computers to communicate with each other (Fairholm, 1986; MacKenzie, 1988). A 1987 survey of computer uses in music education in the schools of British Columbia revealed that a number of secondary schools were using MIDI equipment, and a few elementary schools were exploring computer music composition (Fairholm, 1987). Research supported evaluations of such uses of the computer in music education appear unavailable at this present time.

In the general field of drama and theatre education, computers have been used to produce lighting instrument schedules (Patrick, 1984) and, as drafting software packages became available, full lighting designs (Harman, 1987). Advances in the capabilities of graphics programs have enabled computers to be used effectively for set and costume design (Reaney, 1989).

A different type of computer software program that allows a user to interact with the program in a simulated situation suggests a relationship to drama education. Simulation applications for classroom use are becoming increasingly available. They endeavour to be models of real-life situations which allow no-risk exploration of various alternatives in a given situation. Many simulations developed for classroom use claim to place students in role-playing situations as they explore possibilities and reach decisions regarding such matters as the provision of an airport to a town or the establishment of a nature reserve in an underdeveloped country (Field, Burkill, & Clark, 1986). Such topics are often explored in classrooms through drama role-play. The point has been made that unquestioning acceptance of the finite, preprogrammed choices and outcomes provided by computer simulation exploration of such topics deprives students of the fully satisfying, rich experience that is possible through drama exploration of such topics. In use of a computer simulation, students are merely working through the software programmer's view of the topic and not searching for their own insights (Grady, 1983).

Simulations can also model real-life situations to enable students to practise various skills. A simulation used to teach a basic life skill to students who had mental handicaps promoted a significant gain in knowledge (Browning, White, Barkin, & Nave, 1985-1986). A simulation designed to assist student teachers cope with possible classroom events was evaluated by research and found to be so effective that a recommendation was

made that the strategy should become an integral part of teacher training programs (Buehning & Schieman, 1983).

Opinions as to the effectiveness and appropriate use of simulations are conflicting. Simulations are either approved as fun, challenging, rewarding, effective tools to enhance learning (McQuillen & Ivy, 1986) or strongly denounced for their attempts to replace human thinking processes with a set of preprogrammed solutions (Grady, 1983; Streibel, 1986).

Computer applications in the area of dance education are evolving from work presently ongoing at several universities. Experimental work has resulted in programs that assist in notating and editing dance scores and those that provide a choreographer with graphic tool representations of the human body to enable dance composition and movement refinements in a visual screen format. These programs are predicted to be of value in teaching students the basics of dance composition (Lee, 1988). Because this work is still in developmental stages, its effectiveness and impact on educational practices have yet to be observed and evaluated.

Composition of poetry using a computer takes two forms. The first is use of the computer as a word processor in which case it basically acts as a replacement for pencil and paper. Software designed to instruct and assist in poetry composition has been developed for classroom use. An example is *Poetry Palette* (Mindplay, 1988) which includes a rhyming dictionary and a graphics library to enable composed poetry to be illustrated.

The second form of poetry composition is of an experimental nature. Classified word lists that are provided by the poet are randomly strung together by the computer. Poetry generated in this manner was published in conjunction with an exhibition designed to show some of the creative forms engendered by technology (Masterman & Wood, 1969; Morgan, 1969). Assessment of, or information about, either form of poetry composition in a school setting is lacking. A report regarding the word processing use of computers by grade four students included the observation that work in progress was edited more frequently than when paper and pencil were used for writing tasks, although no specific mention was made of poetry composition (Crawford, 1988).

Art educators have recognized and utilized two different capabilities of the computer: its ability to store and retrieve data and its generation of graphics.

The efficiency and magnitude of data storage and retrieval has enabled collections of art works to be

transferred to disk for use in art history and art appreciation classes. The recent availability of hypermedia software for microcomputers has been recognized as a potentially valuable advance in the use of data bases in art education (Gregory, 1989; Hubbard, 1989). Hypermedia systems allow access through a computer to linked data bases of voice, print, graphics, music, film, and animation. Existing data bases can be modified, or additional ones can be developed by the user. Such capabilities permit a lesson topic to be introduced by a teacher, but each student is able to proceed with the lesson in a different direction according to each individual's interest and ability. Art lessons that utilize hypermedia systems are being developed, and future possibilities for all areas of learning appear limitless.

The capability of the computer to produce graphics has suggested many creative applications to art educators. The simple graphics programs of the mid 1980s have developed into sophisticated *paint* programs. The computer has been accepted as just another medium, a new image making tool, for artistic endeavours (O'Connell, 1985). The fact that artists will use whatever materials are available as devices of their artistic creations is a well recognized fact (Langer, 1957). Artistic works of any particular era reflect the available technology (White, 1985), and the use of a computer as the medium of art requires mastery of the same elements of content, form, and composition as required by any traditional media if a work is to communicate to its audience (Gartel, 1985).

Specific ideas for the use of the computer in art lessons, accompanied by enthusiastic reports of student response and reproductions of the images produced, have been published in journals designed for teachers interested in art or computers. Available in such articles is advice on the possibilities inherent in a particular software program (Clements, 1985), suggestions for the use of poetry to stimulate computer images (Christian, 1985; McClain & Friar, 1986), a description of an approach to encourage appreciation of works of art (Bishop, 1986), and details for using the computer for jewelry designing (Kary, 1986).

Assessment or evaluation of computer use in art education is limited. However, one study which introduced computer art to groups of grade eight and grade twelve students reported a number of positive results. The students were observed to become both artists and observers as they manipulated the medium and found solutions to the generation of personally satisfying images (Kennedy, 1988). Results from a different study which involved a group of talented adolescents were far less positive. A graphics program was used for the instruction of design principles. By the end of the course, improvement in the development of images by

the students was considered by the instructor to be significant, but the researcher remarked that the aesthetic concerns of the students had appeared to run counter to the emphasis placed on planning and design principles by the instructor (Stokrocki, 1986). Another study that involved the use of a computer graphics program by preschool children noted that competency in the use of the program was quickly attained, and that the children demonstrated analytical thought in production of images (English, 1987). The findings of all three studies suggest that children readily accept a computer as a medium for creative visual expression.

Summary

Research that relates to the aesthetic component of fine arts education is rare, but the philosophical base for many current practices has evolved through study of the natural learning patterns and developmental stages of children and is holistic and child-centred. Effects of the integration of disciplines lacks research studies, but the concept of unification is rooted in the holistic approach to education. The initial focus that was placed on reactions to the introduction of computers into classrooms appears to have changed to an exploration of their application as tools for the enhancement of learning opportunities.

The integration of computer technology and the fine arts has been recognized. Turkle, author of *The Second Self: Computers and the Human Spirit*, during an interview with Rhodes (1986), remarked that she had seen interesting uses of the computer as a vehicle for fantasy. Goldberg (1986) observed that when children discover computer music and art, they identify with it as the art of the future and feel themselves to be in a wonderland of possibilities. The computer has thus been recognized as a tool that possesses inherent and unique capabilities for imaginative and creative uses.

An increasing emphasis on the need for creative problem solving skills as opposed to knowledge acquisition must result in greater integration of the arts, sciences, and humanities. All possible resources from all disciplines should be available for exploration and use as they are found suited to a purpose.

CHAPTER 3

RESEARCH DESIGN

Method

Ethnographic research methodology was used to study the phenomenon of computers used as creative media by students in a grade four classroom. The focus for the study was interwoven with the total educational processes and procedures employed in the classroom thus allowing the phenomenon under study to be observed in a naturalistic setting. As both the teacher of the class and the researcher, my role as an unobtrusive participant-observer was natural. Comprehensive and continuing observation and interpretation of events as they occurred and developed was possible. Related data was able to be collected within the context of the problem being addressed. The holistic nature of the exploration of the use in a classroom setting of computers as creative media in the fine arts areas of music, art, and poetry seemed suitably approached through ethnographic research methods.

Time

The study was conducted within the time frame of one school year: from September 1988 to June 1989.

Subjects

The students in this study were a quasi-random group in that their selection was dependent on assignment to my grade four homeroom class at BX Elementary School, Vernon, B.C. during the 1988-1989 school year. Of the 40 grade four students enrolled at the school at the beginning of the school year, ten students who were considered independent workers of good to high academic ability were assigned to a split grade three and four class. The remaining 30 students were assigned to my homeroom, and these children, with the addition of one girl who registered early in November, became the group of 31 students who provided the initial assessment data for this study.

The students were considered to be an academically heterogeneous group. Two boys, although registered in my homeroom, had been identified as learners who required special assistance. These two boys

spent a major portion of each school day in the Elementary Learning Centre classroom but were also integrated into lessons and activities with the homeroom class on a daily basis.

The ages of the students in September, the beginning of the school year, ranged from eight years eight months to ten years seven months. The 31 students, 17 boys and 14 girls, had experienced diverse grade three situations as shown in Table 1.

Table 1

Diverse Grade Three Background of Students

School attended	Number
BX Elementary	
Straight grade three	11
Split grade two-three	4
Split grade three-four	5
Other than BX Elementary	
Same school district	5
Other B.C. school district	1
Other Canadian province	3
Canadian territory	1
Correspondence	1

One boy from this original group of students transferred to a school in another province after seven months. Additions to the class were one boy who was registered for only eight weeks at the beginning of the third school term and a girl who was registered for the last two months of the school year. These two students became involved in the study because of its interrelationship with regular classroom activities.

Approval to conduct this classroom study was obtained from the Superintendent of School District No. 22 (Vernon) (see Appendix A) and the Principal of BX Elementary School (see Appendix B). Parents and guardians of all students involved were informed of the intent and nature of the study by means of an informal letter (see Appendix C) and provided opportunity to discuss the project at either the parent-teacher meeting in

September or when personally contacted. Parents and guardians were provided choice as to the manner in which the individual students might be identified in reporting the data collected (see Appendix D). Consent was obtained for the use of both first and last names of every child participating.

Setting

The setting for the study was a classroom at the BX Elementary School which is situated on the outskirts of the city of Vernon in an area of orchards, small farms, and scattered housing developments. The student population for the 1988-1989 school year was just under four hundred and drawn from a wide range of socioeconomic backgrounds and family-unit structures. The general tone of the school was pleasant and child-centred. Students had free access to most areas in the school building from early morning to late afternoon. This freedom was generally appreciated and respected because the majority of students relied on school bus transportation which necessitated them being on school premises for periods of time in excess of regularly scheduled classes. Many extra-curricula activities of a wide variety were made available for participation both before morning classes and during the lunch hour.

The classroom in which the study was undertaken was relatively large and fully carpeted. Furniture consisted of quadrilateral shaped tables and individual stackable chairs. Considerable flexibility in the physical arrangement of the classroom was possible and many activities took place on the floor and in the hallway which separated the room from the gymnasium. The classroom contained most of the school's music equipment, and the computer workstations against one wall were hemmed by drums and xylophones. Students were permitted and encouraged to use most of the available equipment during out-of-class time and without teacher supervision. The acceptance by the students of simple positive guidelines for the handling and use of the various items of equipment made this freedom of access possible.

The classroom also functioned as the music room for the school. For at least two periods of every school day, I taught music to other grade three to seven classes while students from my homeroom reported to other teachers for instruction in subject areas which included physical education, science, and social studies.

Materials

General

The fact that the research study was undertaken in the naturalistic setting of a classroom presupposed the existence and use of materials and equipment usual for such a setting. Many different materials and strategies were used at the beginning of the school year to assess the previous learning, developmental stage, and potential of each student. The general initial assessment of the students participating in this research included two items that were developed to provide information concerning each student's fine arts proclivity and previous experience with computers. These two items, the computer systems used in the classroom, the computer software, and the reference cards for use with the software are considered the materials specific to this research study.

Fine Arts Affective Domain Development Survey

A suitable measuring instrument that would enable determination of each student's initial affective domain development in fine arts areas was not found in *Tests in Print* (Buros, 1978) nor in *A Beginning Annotated List of Affective Measures* (Human Development Training Institute, 1978). I therefore developed a survey that would elicit the desired information (see Appendix E).

The 20 items listed on the survey were activities that were both possible and probable during a grade four school year. Five fine arts areas, art, dance, drama, music, and poetry, were each represented by four items. Two items in each fine arts area were of an expressive nature; two were of an impressive nature. The odd-even method to determine a split half reliability correlation coefficient was used. Raw scores of 31 students (see Appendix F) gave a Pearson product-moment of 0.89. A t value of 10.77 showed strong correlation even at an alpha of 0.01.

The first three levels of the *Taxonomy of Educational Objectives: Affective Domain* (Krathwohl, 1964) were used as the basis for formulating and assessing response choices. I considered that these three levels were those applicable to students of beginning grade four age and that the selection of responses would adequately reveal each student's affective domain development in fine arts areas. A response to indicate lack of awareness was provided but assigned a zero score. The items were read aloud to the students, but no explanations were provided. Table 2 shows the relationship of the taxonomy to the response choices provided on the survey and the score assigned to each response.

Table 2

Relationship of Affective Domain Taxonomy to Survey Responses and Scores

Affective Domain Taxonomy	Response	Score
	I don't know what this means.	0
1.0 RECEIVING		
1.1 Awareness	I really don't want to do this.	1
1.2 Willingness to Receive	I'm willing to try this.	2
1.3 Controlled or Selected Attention		
2.0 RESPONDING		
2.1 Acquiescence in Responding		
2.2 Willingness to Respond		
2.3 Satisfaction in Response	I'd really like to do this.	3
3.0 VALUING		
3.1 Acceptance of a Value	I'll be doing this anyway.	4

The raw score of each student was related to the maximum score that could be obtained in any one response category. For the purposes of this study, the score was used to indicate the affective domain developmental level in fine arts areas that each student was approaching. A score approaching 20 indicated a developing awareness; approaching 40, a willingness to receive instruction in fine arts areas; approaching 60, satisfaction was being derived from fine arts pursuits; and a score above 60 indicated that the student, or the family of that student, placed value on fine arts activities.

Computer Questionnaire

The students completed a simple questionnaire which I had prepared for the purpose of obtaining information about each student's previous experience with computers (see Appendix G). Items on the questionnaire were designed to elicit a student's (a) access to and use of a computer at home, (b) previous access to and use of a computer at school, (c) prior instruction and present skill in keyboarding, and (d) general attitude toward computers.

Computer Hardware

Two computers were initially available for exclusive use in my classroom. The first was an Apple IIe with monochrome monitor and 5.25 disk drive. The second was an Apple IIGS with a memory upgrade of 512K. The IIGS system included an RGB colour monitor, a mouse, a 3.5 disk drive, a 5.25 disk drive, and headphones.

Additional Apple IIe computers, which adequately handled word processing, were available in the school library, and one which was connected to a Roland printer and used in the school office was available for use in my classroom three days a week.

Both the music and art software programs required the capabilities of an Apple IIGS computer, and I was able to assemble a second IIGS system for use in the final three months of the school year. This second system was used for operation of the music software program because its composite colour monitor provided an acceptable, although not ideal, display screen for only the music program. The original IIGS system with RGB monitor was then able to be used exclusively for operation of the art software. A personally owned ImageWriter II printer with colour ribbon was found useful in that it permitted a bulletin board display of the students' computer art work.

Computer Software

Four different software programs were used by the students. One of these was the training disk, *Your Tour of the Apple IIGS*, which provided practice through short tutorials and games in the use of a mouse as a device to input data and control applications. The other three software programs were of the tool-use variety in that each merely possessed capabilities for open-ended manipulation but made no attempt to tutor the user.

MECC Writer, a product of the Minnesota Educational Computing Corporation (1985), is a basic word processing program that is available on a 5.25 disk. It presents the user with a blank screen and a blinking cursor. Text can be typed, deleted, rearranged, saved to a data disk, reloaded from a data disk, and printed out. All operations are controlled from the keyboard.

Deluxe Paint 11 (Silva, 1987) is a sophisticated commercial graphics program which is designed to enable the creation of images. The program is available on a 3.5 disk. The user is presented with a blank screen and the choice of many drawing and painting tools which are operated by manipulation of a mouse. There are 16 different colours, from a total of 4096, available at any one time. The colours initially chosen for

the palette are able to be exchanged with each other or completely altered during progress of any work. Images that are generated can also be modified in respect to size, shape, and colour; moved, rotated, and reproduced; and otherwise used in an infinite number of ways.

The Music Studio (Forrester, Hospelhorn, Parfitt & Wickman, 1986) is a commercial software program, available on a 3.5 disk, designed to enable the composition of music. The main screen presents a blank grand staff and offers a selection of notes, rests, and other components of music notation which are positioned by manipulation of a mouse. A selection of 15 different instruments is available at any one time. Colour coded notes are used to indicate the currently selected instrument. Compositions can be transposed, note durations can be doubled or halved, instrumentation can be changed, and the work in progress quickly altered in many other ways. Immediate performance of the composition is possible. One additional feature allows for the creation of unique sounds by the manipulation of the sound envelopes of the programmed instruments. The sounds created are then able to be used in compositions. Another feature, termed the *paintbox*, allows the user to switch from the main screen that displays the grand staff and traditional components of music notation to a screen that presents the different notes as rectangles sized in relation to duration and colour coded to the instrument sound selected.

Reference Cards For Use With Software Programs

Students using the computers needed to be able to work independently with minimum supervision and instruction while I was occupied with lessons and activities which involved the majority of the class members. For this reason, I prepared sets of reference cards to assist independent use of the software programs.

The instruction manuals for use with both the music and art software I considered to be too detailed and of a reading level above that of most grade four students. I therefore prepared a set of 12 reference cards for use with the music software program (see Appendix H) and a similar set of cards for use with the art software program (see Appendix I). Both sets of cards were designed to encourage sequential discovery of some of the capabilities of the programs as well as to provide a quick reference when procedural details needed to be checked. These sets of cards were kept in a file box beside the Apple IIGS computers.

Keyboarding skills were required for efficient use of the computer word processing program, and regular practice was necessary to build and maintain the skills. I therefore prepared a set of 40 file cards containing groups of words that provided sequential practice of keyboarding skills (see Appendix J). These cards were

kept in a file box beside the Apple IIe computer and allowed students to practise, review, and develop skill in keyboarding various combinations of letters and symbols at their individual levels.

Data Collection

Initial Student Profiles

Individual student profiles were compiled at the beginning of the school year to address the organismic variables concerning the preexisting characteristics of the students in this study in respect to fine arts and computers. The data that contributed to each student's profile was entered on individual profile forms which I developed for this purpose (see Appendix K) and included name, gender, and birth date.

Information that would indicate each student's fine arts proclivity was entered on the profile forms. The raw score obtained on the Fine Arts Affective Domain Development Survey was shown as a point on a line which represented affective domain development progression. Information relating to scores obtained by the whole class was noted on every sheet for easy reference and comparison.

Triangulation of the survey results was provided through two of the many outcomes of an integrated language and mathematics unit based on the theme of self-discovery. One outcome provided information as to how the students perceived themselves and each other in relation to being most oriented toward academics, athletics, or fine arts. This information was presented on the profile form as a bar graph. The second outcome provided information regarding out-of-school activities such as group memberships, events, and lessons that were a regular part of each student's life. Categories of activities were listed on the profile forms.

Information obtained from the Computer Questionnaire which was completed by each student was presented in table form. Any previous experience with computers at home or school, keyboarding ability, and attitude toward computers were indicated.

The completed student profiles provided an indication of each student's involvement with, and relationship to, both the fine arts and computers and also provided an overview of the students as a classroom group. Comparison between individual students and between individuals and the group as a whole were readily observable.

Time Spent in Computer Use

Some indication of the amount of time spent by students in computer use was considered desirable.

Areas of interest were (a) the total time spent by individual students; (b) the relative amounts of time spent on word processing, art, and music by individual students; (c) the relative amounts of time spent on word processing, art, and music by the whole class; (d) the amount of out-of-class time spent by individual students; and (e) the time required by individual students to bring any one project to completion.

To facilitate the collection of such data, a computer time log sheet was prepared (see Appendix L). In the first months of the study, copies of this sheet were used by the students to sign up, record beginning and ending times, and indicate which software program was in use whenever they spent time at a computer. A small digital clock on the wall above the computers enabled the accurate recording of times. I performed the calculation of the time spent by each student in use of the computers.

During the final months of the study when at least three computers were in constant use, copies of the sheet were colour coded to indicate the computer and program in use: white for word processing, blue for music, and yellow for art. The time slots were set in 20 minute segments that coincided with the schedule in place for the whole school, and students were assigned to each computer program on a rotating basis. Time slots covering out-of-class time were left free for sign up by students who chose to do so.

Recorded Observations

Journal. From the beginning of the study, I notated, almost daily, general and specific observations; thoughts; summaries of readings and discussions; and procedural steps planned, attempted, or accomplished that related in any way to the research being undertaken.

Informal observations. From the beginning of January, the fifth month of the study, copies of an informal observation form (see Appendix M) were placed on my desk in the classroom where they were accessible at all times. The format of these sheets allowed quick notations regarding events in the classroom as they occurred even when I was engaged in other classroom commitments. Each sheet was dated, the particular observation and the names of students involved were noted, the software program in use circled, and the block of time during which the observation took place indicated by a letter code.

Formal observations. Whenever classroom circumstances allowed me to dedicate time to such activity, formal observations of individual students engaged in computer use were undertaken throughout the final three months of the study. A form was prepared to facilitate the comprehensive notation of time, actions and verbal responses of the student who was operating the computer, and the participation and interaction of

any spectators present (see Appendix N). Detailed and specific observations covering uninterrupted time spans of several minutes' duration were recorded.

Videotape. A video camera was used to record a total of three hours of extended periods of classroom activity during the final month of the study. The camera was positioned on a tripod against the wall opposite the computer workstations and thus captured the progress of the work being done by the students who were involved in use of the computers. The activities of the students who were using the computers were also able to be viewed in relation to the activities and work of the remainder of the class members and my own participation as the teacher and researcher.

Interviews

During the final weeks of the study, individual interviews with 29 of the participating students were tape recorded. These interviews provided one aspect of triangulation for the recorded observations. Each interview was conducted at a time when the student was working with a computer and included a short discussion about the work in progress. Students were asked to comment on the particular computer program they most enjoyed and the amount of out-of-class time they had chosen to spend in computer use. Reactions were sought regarding possible effects on other work caused by scheduled individual time for computer use during regular classroom lessons and activities. Opinions about, and reasons for, any expressed preference for the production of written work by word processing or use of pencil and paper were discussed. General comments about the computer applications experienced during the school year were invited, and each student was asked about any future computer project that he or she might like to undertake.

Computer Work Produced by Students

All computer work produced by the students was retained for review and analysis and provided an additional triangulation aspect for the observations recorded during accomplishment of the work. Computer work saved on disks and the presentation formats of some of the finished products comprised the two categories of data concerning the work produced by the students.

Work saved on disk included experimental explorations of the capabilities of the computer medium; written work, images, and music compositions in various stages of progress; and completed works. Word processed work was saved on six 5.25 disks that had been shared by groups of five or six students. The work saved during use of the art and music programs was stored separately on a total of 65 disks. The majority of

these 3.5 disks each contained the work of an individual student.

Completed computer work in presentation format included printed word processed poetry, art images both printed and converted to slides, and taped music compositions.

Audience Response to Computer Generated Work

Responses to the computer generated work by both the students participating in the study and nonparticipants were noted and recorded to provided further triangulation for other observations made during this study. The students evidenced spontaneous responses to their own work and to that of other class members throughout the progress and at the completion of various pieces of work. Such responses were observed and notated as they occurred.

Written response to the published poetry was invited and facilitated by the provision of reader response forms attached to the poetry booklets that were distributed to other teachers and to the families of the students. Audience reactions and responses to the hallway displays of poetry and art and to a multimedia presentation of art and music were observed, noted, and recorded in the journal that had been maintained during the study.

Data Analysis

Collected data comprised (a) the initial student profiles, (b) some indication of the actual time spent by students in computer use, (c) extensive field notes in three different formats, (d) videotapes of regular classroom activities, (e) taped interviews with 29 students, (f) 71 disks that contained computer work produced by the students, (g) computer work in presentation format, and (h) recorded responses to the work produced.

Analysis of various components of the data was ongoing throughout the study and often provided direction and suggested sequencing for the provision of classroom learning opportunities and activities.

The completed profile forms provided some indication of each student's proclivity toward the fine arts. Synthesis of the information contained in the individual profiles indicated the general development level and interest in the fine arts displayed by the class as a whole. Direction was thus provided in the selection of appropriate teaching strategies and topics for lesson plans.

Information obtained from the computer questionnaires was used to decide the nature and extent of instruction required by the students in the areas of computer operation and keyboarding skills before the focus for the research problem could be addressed.

Initial observations were guided by the foreshadowed problems which could be summarized as concerned with the extent of use of various elements in the composition of poetry, art images, and music in relation to the unique capabilities provided by a computer for revisions to, and performance of, work. These initial observations promoted modifications to the originally formulated foreshadowed problems, and subsequent observations were focused on the more general problem of what could be learned about the creative development of the students when they used computers as creative tools.

The observations that I made as the participant-observer, teacher-researcher, were considered in totality in their final interpretation. Triangulation of my observations and impressions was provided by the videotape which enabled observation of the phenomenon under study from a different perspective. During my viewing of the videotape, I, the observer, became the observed. Triangulation from different data sources was provided by the comments made by the students during my interviews with them, my contemplation of the total work produced and stored on disks, and responses to the computer work by the students and by others to whom completed work was presented.

Procedure

General

This ethnographic research study was conducted in the naturalistic setting of a classroom in which the teacher was also the researcher in a participant-observer role. The procedure for the research became part of, and interwoven with, all procedures employed in the classroom during the school year. Various procedural steps produced results that allowed and often directed ensuing steps.

The focus for the research was to observe and analyze what happened when grade four students used computers as creative media in the fine arts areas of poetry, art, and music. One procedure that related to the study was part of the general organization of the school. The students involved in the study were provided two periods a week of instruction in both art and music. I taught the regular music lessons, and another member of the school staff taught the art lessons. We both approached instruction in a developmental sequential manner and made use of a wide variety of traditional media. These regularly scheduled lessons were in addition to the work involving use of computers as creative media in art and music.

A procedure that I used in language arts throughout the school year also related directly to the research

study. Writing of both an expository and a literary nature was accomplished through the developmental procedure, the writing process, which involved prewriting activities, draft writing, editing, proofreading, publishing, and presenting. A procedure that elicited written responses to any published work that was presented to other teachers or families of the students was established in the first week of the school year. A simple Reader Response Form that consisted of five blank lines and a place for a signature was attached to any published work that was distributed.

The consistent use throughout the school year of poetry in many forms and for many purposes was a personal instructional procedure that also related directly to the research study. Integration of poetry with many learning experiences ranged from an exploration of visual poetry, which began with the addition of sketches to printed words selected from prescribed spelling lists, to the interpretation of lyric poetry through sound and movement during scheduled music lessons.

Other procedural steps considered to be of major importance to the study divided naturally into three clusters of concurrently accomplished steps that coincided with the three terms of the school year: term one, September to December; term two, January to March; and term three, April to June.

Term One

Observations during the first term of the school year were recorded in journal format. Procedural steps that were undertaken concurrently during this period of time primarily established a base that made possible the study of the specific research problem.

1. Data used in the compilation of the individual student profiles was collected through activities that were both curriculum oriented and directed to the gathering of information that would assist in general assessment of a new class of students. As an example, birth dates were obtained at the culmination of an activity in which the students had been asked to line up without speaking in order of the occurrence of their birthdays throughout a calendar year. The birth dates provided by the students were checked for accuracy with information contained in official school records.

Each student profile form presented the affective domain development level for the student as indicated by the survey raw score, the self-perceived orientation of that student, the way in which the student was perceived by peers, and the activities in which the student was actually involved in out-of-school time.

The unit of work that provided the data that was entered on the profile forms included many opportunities

for the students to become aware of their own and others' strengths, weaknesses, preferences, and special talents. Orientation toward academics, athletics, and fine arts was explored through reading and classification of articles in children's magazines. The classification terms were additionally clarified through an activity in which the students created in tableau form statues to be placed outside various Halls of Fame including those of Athletics, Academics, and Fine Arts.

The information regarding the perceived orientation of self and peers was derived from an assessment made by each student and indicated by check marks in appropriately headed columns on duplicated class lists. Opportunity was also provided each student to indicate which peer they considered to display the most orientation in any category. There was no compulsion to categorize a peer about whom any student felt unable to comment, and a column headed "None of These," in addition to the columns labeled "Academics," "Athletics," and "Fine Arts," attempted to avoid forced categorization.

The lists of out-of-school activities were provided by the students and were part of the data that they had collected in groups in order to present the information in graph form.

2. The writing process was reviewed or, in the case of several students, introduced through a project that required each student to write a report about the holiday activities of another class member whom they interviewed to obtain the necessary information. The reports were published and distributed at the end of the first week of school in the format of a newsletter.

Another writing project during the first school term resulted in publication and distribution of a booklet of short articles in which each student discussed his or her own name. Each article was accompanied by a visual treatment of the student's first name in the manner of the visual poetry that had been explored by the class.

The publication of both these writing projects that were presented in formats suitable for distribution was accomplished in the students' own hand writing or printing.

3. Care for, and basic operation of, computer hardware and software were addressed in conjunction with instruction in keyboarding. My major objective in keyboard instruction was that each student attain a skill level at which keyboarding became a practical alternative to hand writing. Emphasis was placed on correct posture and finger placement. Accuracy, not speed, was stressed, and touch typing was encouraged but not demanded.

I had developed a simplified sequential approach to keyboard teaching and introduced at any time only one new key. Keyboarding skills were introduced and developed through daily lessons of ten to fifteen minutes

duration. A rotation system allowed two students each day to use the computer keyboards during these lessons while the remainder of the students used cardboard models of a keyboard. All students were encouraged to use the computers for keyboard practice at any time during the day when a suitable opportunity arose. The reference cards that listed words requiring various combinations of keys were available, and students were introduced to the system for recording the times when they used computers.

The keyboarding lessons provided opportunity to teach the two students who used the computers each day how to load the word processing program and how to quit the program correctly after use.

Term Two

Observations during the second school term were recorded in journal format and on the informal observation forms as events occurred in the classroom. The procedural steps during this time period were mainly concerned with introduction of the computers as tools or media that could enable creativity.

1. The daily draft writing of a thought about a particular topic or object was an activity that facilitated many developments. The activity encouraged and provided many opportunities for students to explore the use of imagery, metaphor, and simile in their writing. Rotating use of the two computers for the daily draft writing demonstrated a use for the students' developing keyboard skills and introduced the concept that computers could be used as creative media. Two students each day were taught the basic procedures required for word processing: how to perform simple editing tasks and how to save and retrieve work in progress.

Each student contributed a short word processed selection of prose writing to a booklet that was titled "Thoughts." Preparation of this booklet for publication provided a practical reason for each student to learn how to use a printer to obtain hard copies of their word processed work.

2. The training disk supplied with Apple IIGS computers, *Your Tour of the Apple IIGS,* was introduced to enable students to become familiar with a computer interface system that required manipulation of a device known as a mouse to input data and control applications such as *The Music Studio* and *Deluxe Paint II.* Students were encouraged to use any available time to work with the training program. A class list was used to create a check list of the various tutorials available on the training disk, and students checked the items that they completed.

The Apple IIGS computer was required to operate the training disk. Because this computer was also in demand for word processing, the students were provided many opportunities to practise loading, quitting, and

changing programs using both the 5.25 and the 3.5 disk drives.

3. *The Music Studio* software program was introduced to the class during a scheduled music period, and the *Deluxe Paint II* software was introduced through a short class lesson a few days later. Students were assigned ten minute time slots for computer use on a rotating schedule during class time but were permitted to sign up for longer periods in out-of-class time. The reference cards for both software programs were available as guides, and students were allowed free exploration of the possibilities they discovered in the programs.

Only one computer capable of operating the music and art software was available during this time. One program was used during class time until all students had received a scheduled time for its use. Students who were able to work before and after regular school hours were permitted to load the program of their choice.

4. At the end of the second school term, one example of each student's art work was printed for display on a hallway bulletin board.

Term Three

During the third school term, formal observations were added to continuing informal observations and journal notations. Provision of the second Apple IIGS system enabled each of the three computers used exclusively in my classroom to be dedicated to the operation of one software program. Rotating scheduled time slots of 20 minutes duration allowed most students to use a computer at least once every day. Procedural steps during the third term were concerned with use of the computers as creative media, presentation of completed computer work, and collection of additional data.

1. A unit of work that included opportunities for students to read poetry from a selection of over 50 anthologies, present a chosen poem to the class, discuss and compare poems of different styles, and formulate opinions regarding purposes for writing poetry preceded the provision of several blocks of time during which students were encouraged to draft write their own poetry. No specific topics were prescribed for the poems, but the students had each completed a sheet of open-ended sentences that elicited matters considered important, and these sheets were often referred to by individual students as they decided on a topic for a poem.

During the blocks of time provided for draft writing of poetry, the students who were scheduled to use the word processing computer used it as their medium to draft a poem. My suggestion that each student attempt to draft a poem using the computer as medium met with approval. Additional Apple IIe computers were made available in the classroom or in the hallway outside the room whenever possible to provide more students with

scheduled time for word processing of their poems.

2. A class brainstorming session produced the decision to print at least one of each student's word processed poems and present the collection on a banner to be displayed in the main hallway of the school. The students agreed to my suggestion that the poems also be published in booklet form so that they could be read by a wider audience.

3. In the continuing use of the art and music software, no expectations regarding finished products or requirements as to the content or topic of work were placed on the students. They were given freedom to explore and develop possibilities during their scheduled times for computer use and whenever they signed up to work in out-of-class time.

4. An expressed desire by the students to present their computer art work and music compositions to an audience outside the classroom led to a discussion about how this might best be accomplished. The decisions arrived at through this discussion resulted in the multimedia presentation of "Sights and Sounds" in the school gymnasium during the final week of the school year. Other classes and family members of the students were invited to the presentation.

Preparation for the presentation required that each student select four examples of his or her own computer art work which I photographed from the monitor screen for development in slide format. The music composition that each student selected to accompany the automatically timed showing of four slides required a performance time of just under one minute. When all students had their timed compositions ready, I used a patch cord connection from the computer headphone outlet to tape record them in the correct sequence for presentation. The students had made the decision to present their work in a sequence determined by the alphabetical order of their last names.

A program for the presentation was word processed by a student who volunteered for the task. Students provided titles for each selection of art work and for each music composition.

5. A video camera was used to record student use of the computers during regular class activities for a total period of three hours during the last month of the school year.

6. I tape recorded interviews with 29 students who participated in the study during the last two weeks of the school year.

7. Written responses to the students' poetry were removed from display and filed. Audience responses

to the students' computer art and music presentation were observed and notated.

8. All computer disks that contained students' art, music, or word processed work were collected. All computer work in presentation format was also collected.

Analysis of Data

Although the analysis of data had been ongoing throughout the duration of the study, final analysis of data was undertaken after the school year ended. The data was thus able to be considered in totality before final conclusions were drawn.

Summary

The design for the research study was incorporated into the overall design for learning that was used in a grade four classroom throughout a school year. A naturalistic setting for the study was thus maintained. The teacher, in a participant-observer role, used ethnographic research methodology to study a particular phenomenon in the classroom setting.

The phenomenon studied was student use of computers as creative media in the areas of poetry, art, and music. Skills necessary for the operation of computer equipment were taught and developed, but use of computers in the classroom was directed to their function as tools that enabled creative expression.

The focus of the research was on what occurred when the students used computers as creative media. Because the research design was integrated with the total learning design used in the classroom, collected data and the findings that applied to the research question were also related to the total classroom situation.

The research problem encompassed the disciplines of music, art, and language. Work that was based in such a broad range of expressive disciplines provided a broad range of learning outcomes. During this study, computers were used as tools that enabled creative expression. Many findings that resulted from the study were specific to the use of computers as creative media for composition of poetry, art images, and music. Some findings related to the total learning situation in which the study was undertaken.

CHAPTER 4

DESCRIPTION OF FINDINGS AND ANALYSIS OF DATA

General Overview

The findings from this study were derived from a collection of data that was integrated with the learning experiences that occurred in a grade four classroom throughout a school year. Altogether, 33 students were involved in the study. The majority of these students were nine or ten years old. The research problem concerned the students' use of computers as creative media in the fine arts areas of poetry, art, and music. Findings were both specific to these discipline areas and of a more general nature. The findings were considered and analyzed in five major categories.

The students who were the subjects for the study were considered first. An initial assessment of these students was made in relation to their proclivities to fine arts areas and their skill and experience in use of computers. Matters that related to the time involved in use of the computers during the study were considered next. The aspects of time addressed were the actual amount of time that students spent in computer use, the time required for the completion of any single project, and a general assessment of computer use time as it related to the total classroom situation. The third group of findings concerned the skills and knowledge that the students acquired to enable them to effectively use the computers as creative media. The use of the computers for word processing prior to their use for poetry composition provided a fourth aspect that related directly to the study. Specific findings that concerned the use of the computers as creative media in each of the three areas of poetry, art, and music were then addressed.

A final summation of findings viewed the use of computers as creative media in relationship to the total classroom situation that existed and developed throughout the school year.

Initial Assessment of Students

Initial interactions with the students who were the subjects of this research study provided a general impression of the class dynamics generated by the group. I recognized a group of high energy level students. The class welcomed opportunities for movement and oral expression but appeared reluctant to approach

activities that involved reading and writing. Within the group there were quiet students and those who appeared academically capable, but many of the highly visible students who were setting the tone for the group were performing poorly in traditional academic areas and exhibiting low self-esteem in often heard comments which included, "I don't like reading," "I can't do math," "My brother says I'm stupid," and "I'm not very good at spelling." I therefore developed the tentatively planned unit of work into which the research components of student assessment were to be incorporated into a major unit that focused on self-discovery and the building of self-esteem.

During this first major unit of work, each student responded to the fine arts survey that I had devised to provide an indication of affective domain development. A frequency polygon of individual student raw scores (see Appendix F) is shown in Figure 1.

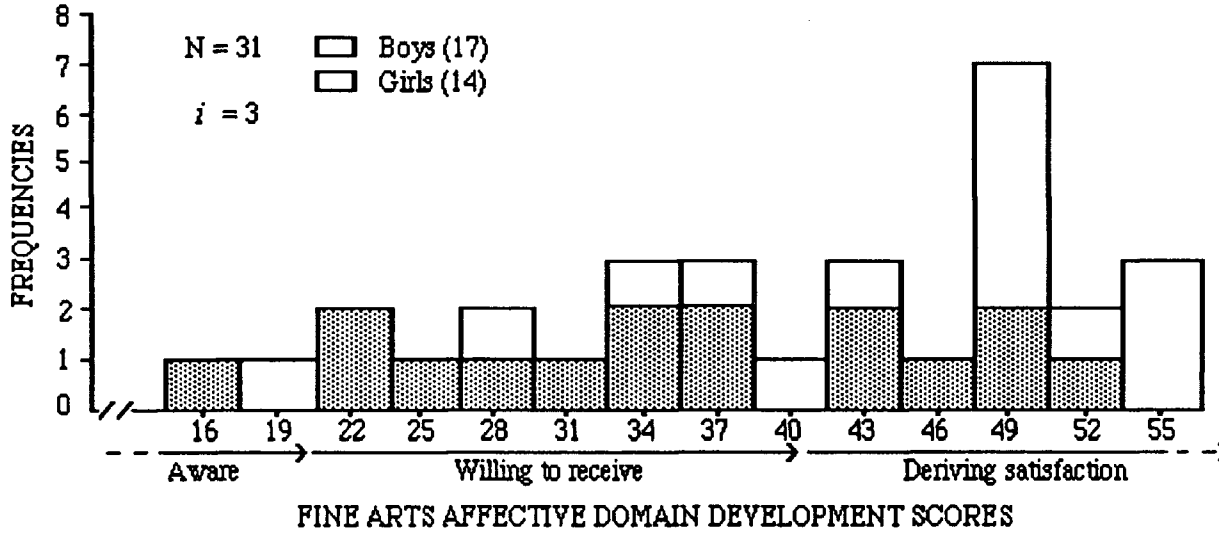

Figure 1. Frequency polygon of raw scores obtained from fine arts survey.

The frequency polygon revealed a negatively skewed distribution with a mode of 48: a score which indicated that satisfaction was derived from fine arts activities. However, the mean for the total of 31 students was 39.23: a score that indicated definite willingness to partake in fine arts experiences.

The subtotals of the raw scores obtained for the expressive and impressive survey items (see Appendix F) with $z = 0.68$ showed no significant difference at an alpha of 0.05. The subtotals of raw scores obtained by the boys and the girls (see Appendix F) with $t = 1.79$ also revealed no significant difference at an alpha of 0.05.

The results of the data analysis were consistent with my expectations of grade four students at the beginning of a school year. The majority of the students appeared willing to explore and participate in a wide range of experiences.

A total raw score of 1216 was obtained by the 31 students. Distribution of the total score among the five fine arts areas is shown in Table 3.

Table 3

Percentage Distribution of Raw Scores in Fine Arts Areas

Fine Arts Area	Percentage	Raw Score
Art	24.8	301
Drama	20.7	252
Music	18.6	226
Poetry	18.5	225
Dance	17.4	212

The fact that the survey items that related to art received the highest percentage of the total raw score could indicate that art was the area in which the students felt most capable and was therefore the area in which they expressed the most interest and knowledge.

When students were asked to classify themselves and their peers in relation to perceived orientation toward academics, athletics, or fine arts, sixteen claimed orientation toward athletics, eight claimed fine arts orientation, and seven claimed academic orientation. In 22 cases, the majority of their peers agreed. The large number who claimed and were seen to possess orientation toward athletics suggested that this was the area where students had received greater opportunity to observe and assess their own and others' abilities and activities. Most of the boys were considered by their peers to be athletically oriented. A girl received the strongest and most consistent assessment by peers as the student who displayed the most orientation to the fine arts.

Six students claimed that they were not involved in regular activities out of school time, but the others were involved in a wide variety of activities that included lessons in team sports, self defence, instrument

playing, dance, and a second language. Club and group memberships were often related to lessons being taken but also included Guides and Cubs.

The computer questionnaire revealed that all but four students had previously used computers at school, and six had access to home computers. The major use reported was for game playing, although two students mentioned keyboard practice, and one boy said that he wrote stories at home. Apart from this one boy, the 20 students who claimed to have been taught keyboarding had experienced no application of the skill to a computer keyboard. I therefore assumed that 15 of the 18 students who indicated their keyboarding speed on the questionnaire had misinterpreted the question. Discussions with these students confirmed that they held vague ideas about the relationship of keyboarding to computer use and had been referring to the speed with which they could operate keys in the playing of arcade type games.

Attitudes toward computers were expressed in positive terms although one girl admitted that she didn't know how she felt about computers. The 12 students who claimed that they would name a personally owned computer provided names that I classified as five robot type, three female, two male, one pet, and one functional type. Although this number of responses was limited, it was interesting to note that a similar question posed by Vermette, Orr, and Hall (1986) had resulted in a definite tendency to choice of male names, and robot type names had received no mention.

The majority of my students appeared to accept computers as standard items of equipment whose major application was to game playing. This initial assessment was confirmed by many spontaneous comments of the students during later stages of the study. In early May as one girl waited patiently for a computer to perform a rather complicated operation that she had requested in creation of an image, she sat back in her chair, watched the monitor screen intently, smiled, and remarked, "I thought computers were only for playing games."

The completed individual profiles that provided a summary of the data collected concerning each student's proclivity to fine arts and previous experience with computers indicated that all students were within the boundaries of what I as an experienced classroom teacher would consider typical in a heterogeneous group of beginning grade four students in that type of school setting. The revealed willingness to learn and to accept experiences of a wide variety I considered typical for children whose ages encompassed the developmental stage of concrete operation in exploration of their environment (Inhelder & Piaget, 1958). Raw data that would allow future understandings and decisions was being amassed willingly from many sources. The general position of

children at the concrete operational development stage was succinctly expressed during the first week of the study by the boy who commented, "I don't think I've found myself yet."

Matters Related to Time Spent in Computer Use

Actual Time

The time spent in computer use by students during this study was time individually spent both during and outside of regular class hours. The number of students involved in computer use at any one time was dependent on the number of computers available. A minimum of two computers was available during the first and second terms of the school year; three during the final term. One afternoon, when poetry was being completed and printed for presentation, a total of eight computers was used. Computers were available for use by individuals at any times except those when the students were scheduled to be in a different classroom with another teacher while I taught music to other classes. This approach taken to computer use, as opposed to regularly scheduled computer laboratory class periods, made the assessment of time spent in their use rather complex.

The actual time that computers were in use during any one school day gradually increased from about an hour a day at the beginning of keyboarding instruction to almost full time use during the final three months of the study. The computer time log sheets provided the means to obtain some indication of time spent in computer use by individual students throughout the year. The times recorded on the sheets indicated that each student had been provided at least 17 hours of scheduled class time during the school year. A relative perspective on this amount of time can be gained by noting that daily 15 minute recess breaks throughout a school year total 48 hours. No student accepted the officially scheduled time as maximum. All chose additional periods of time, including recess and lunch breaks, to sign up for extra computer time.

Because of the freedom given in choice of additional computer use time, the amount of time spent in computer use by individuals varied greatly. Some students who, because of bus transportation schedules, arrived at school an hour and a half before morning classes worked out their own system for time sharing and often neglected to notate times on the log sheets. Observation revealed that several of these students were spending an almost daily 30 minutes in computer use before morning classes. The use of computers as media became so accepted and integrated into classroom practices that students often forgot to note their times of use.

When I asked one girl who had been word processing if she had remembered to use the time log sheet, she told me in a slightly indignant manner, "No, I've been working." The fact that she had been using a computer as her medium was completely secondary to the fact that she had been writing a story.

The duration of individual sessions of computer use ranged from short two minute keyboarding practices during the first school term to several two hour sessions after class time during the third school term. Three boys and two girls often made special arrangements with their parents which allowed them extended time in computer use. These extended periods of time were most often devoted to use of the art software program. The choice of 20 minute time slots for the structured rotating schedule put in place during the third term was an outcome of observations made during the second term. During that period, I observed that 20 minutes was about the average time voluntarily spent by individual students in computer use.

Because of the various systems developed throughout the year to provide equal in-class time to all students, time spent in use of word processing, art, and music software was relatively equal. However, during the second term when only one computer was available for operation of both the art and music software, an occasional class vote was taken to decide which program to load and invariably resulted in use of the art software.

Compositional Time

One of the questions most often asked by adults who saw, read, or heard a student's computer generated work concerned the time the student had taken to accomplish the product. There is no simple or single answer. Finished products were often developed using portions of several sessions during which a student would also experiment with ideas or spend time on other works in progress. Poetry and art images were often brought to completion in this manner but were also produced in a time span of a few minutes.

A demonstration that a poem could be written and printed in two minutes was given after school hours one afternoon in May. I was about to cut a roll of paper and thus put an end to the poetry banner that had been daily increasing in length over the period of a week when Greg demanded I wait because he still had one more poem in his head. He raced to the word processing computer that was connected to a printer and produced his visual disappearing-name poem just in time to have it included on the banner. Other poems written by Greg had each required several sessions at a computer to bring to a finished state.

Similarly, completed art images sometimes were produced in a few minutes or sometimes saved,

reloaded, and reworked over a period of several days. Finished music compositions were usually the product of ongoing work during several computer use sessions. Christine's "Dancing Notes" with a performance time of just under two minutes was composed over a period of two weeks in at least five separate work sessions.

The time taken to produce a piece of work that was considered finished by the student who produced it was influenced by the origin of the creative idea that stimulated the work. Finished works of poetry, art, or music expressed ideas through use of techniques and effects that students discovered possible in the computer medium. A particular discovery sometimes led to spontaneous expression which resulted in a rapidly completed work, or experimentation with several techniques and effects would provide an idea that required a longer period of time to express in completed form.

The spontaneous use of a technique that Sasha randomly explored was the stimulus for an image that he produced and titled "Textures." Sasha had spent four minutes filling the monitor screen with doodles and selecting various sections of the doodles to use as brushes to make more doodles. He suddenly sat forward in his chair, cleared the screen, and used the brush in which he had seen possibilities in curving downward strokes that quickly filled the screen. He sat back and looked at what he had done. Two boys who had been watching and making excited sounds during progress of the work simultaneously exclaimed, "Save it. Save it." Sasha saved the image and eventually chose it as one he wanted to present to an audience. The whole process had taken two minutes.

The image that Carrie titled "Tennis Court" originated in an idea for a finished work that combined several different techniques and effects. Carrie had previously experimented with pattern fills and brush rotations. Any design or pattern could be created and used to fill a defined space, and sections of images that were made into brushes could be flipped vertically or horizontally and rotated any number of degrees. A particular pattern fill suggested to Carrie a wire mesh fence and became the initial stimulus for an image that depicted two players against the background of a tennis court fence. Carrie drew only one tennis player, converted the image into a brush, and flipped it vertically to create the second player. A total time of at least two hours in daily sessions over a period of one week was used to complete the image.

How much time does a poet, artist, or composer take to create a finished work ? There can be no finite answer as the students involved in this study demonstrated.

Reflective Time

A matter directly related to the time spent in computer use forced the students and me to explore a philosophical question. The realization that such an event had taken place and the understanding of its import were appreciated only through reflection months after the students and I had actually faced and dealt with the question that had been raised.

Near the beginning of the second term when students began to spend increased time in computer use, I became aware that class time used for computer work had apparently had no adverse effects on students' other work. I reflected on this aspect of the study and recalled my response to the first student who had told me that a particular project that had been allotted class time over a period of several days was incomplete due to the fact that he'd been working at the computer. I had responded with the remark that time spent at the computer would not be accepted as an excuse for incompletion of important work. After I'd made the statement, I realized that a value judgement question had been raised in regard to what constituted important work. A class discussion on the topic caused all of us to examine closely the underlying reasons for, and objectives of, many activities at which we spent time during a school day. I could not recall a subsequent incident in which a student had tried to claim that time spent with a computer was the reason for incomplete work. A potential problem had somehow been averted.

Consequently, I observed individual students as they left the class activity to work at computers and as they returned to the class group after their scheduled times for computer use to find out how they handled the transition and what was done concerning work they had missed. I noticed that students who returned from computer work to their group tables usually received any missed instructions in a concise manner from one or more of their fellow students. A typical example of the assessment of the importance to the individual student of a section of work was verbalized by one boy who had missed a written activity that I had used to help focus the students on a mathematics lesson. I overheard his comment that he didn't need to do the activity because he already knew how. I silently agreed with him.

An often used strategy was for one student to assume the responsibility for ensuring that a peer did not miss any class work considered to be of importance. A frequently heard comment made as one student left the group to work at a computer was, "I'll tell you if you miss anything." Follow up to this promise was obvious in the number of students who came to me in pairs, one, who was invariably adopting a teacher-like role,

remarking that he or she was just about to, for example, read the story with, or test the spelling of, a student who had missed the particular activity while working at a computer. Many such instances of peer assistance were undertaken during recess and lunch breaks. I monitored the teaching and learning that ensued as closely as possible but in an inconspicuous manner so as not to detract from the responsibility being accepted by the students.

Students who worked with the word processing software during the period of time when it was mainly used to enable keyboarding practice sometimes attempted to word process the written work in which the class was engaged. Cursive writing was a developing skill for most students, and periods of time were devoted to concentration on letter formations and connections. During one such period, the student who was working with the word processing software claimed my attention to proudly show me how she had practiced her writing at the computer. Several students managed to use the word processing program to present mathematical calculations in the same column format style that they used in their notebooks.

I realized that the students were being provided many opportunities to assess the importance to themselves of any classroom work that was missed, use a wide range of problem solving strategies to cope with their assessments of various situations, and gain self-esteem through assistance given to their peers. The classroom time spent in computer use had many positive side effects.

I broached the topic of the effects of missed class time due to scheduled time for computer use with the students that I interviewed at the end of the school year. Not one student indicated that he or she considered the topic important or that any classroom work had been missed. One boy stated in a matter of fact way, "You know what's going on behind and around." Several students reacted in a manner that indicated surprise that I should even have considered that computer use time may have caused a problem. A girl assured me that she had experienced no feeling of deprivation by her remark that, "Other people are having fun, and I'm having fun too." A boy provided a thoughtful summation of the situation when he said, "It's like class work, but you're working on a computer. You have music in class work and art in class too, but computers are more fun. They can do a lot of extra things."

My initial concern that work being done at the computers in the midst of other classroom activities would prove to be a distraction was unfounded. Two or three spectators would often pull chairs over to the computers, many times rather noisily, but then, with only an occasional comment or question, would quietly

watch whatever was being done at the computers. With very few exceptions, enquiry revealed that these spectators had made responsible decisions about the way in which they were spending their time: assigned work was completed or they sometimes were taking a well earned and well timed break. The spectator aspect of computer work proved an important component in the transfer of knowledge, skills, and techniques among the students, and I approved and encouraged the activity.

The only time that the whole class was distracted from a lesson that I was giving by an activity that was taking place at a computer became a learning opportunity for all of us. We were all on the floor. The students were sitting in a group facing me. The computers were to one side of the area where we were involved in a discussion. Pairs of eyes began to flicker in the direction of the computers and then back to me. Expressions on faces showed concern. There was obviously a problem at one of the computers, and full attention to the lesson in progress would not be possible until that problem was solved. We all gave our full attention to the girl who was looking despairingly at the monitor screen used for the art software. She read to us the contents of the dialogue box that had appeared on the screen as she tried to save an image to her disk. No student in the group had before this time been presented with the dialogue box that indicated an illegal file name. I asked what name she had attempted to use for the file and was told "3-D." Before I had time to even assess what the problem might be, a boy called out, "You could name it 'D-3'." He was correct. He explained that he knew that his solution had to work because he had named some of his images with a number at the end. Many students indicated that they understood his reasoning, and we continued the lesson.

One of the videotapes that had recorded classroom activities allowed me to see the effects of a digression for which I had been responsible. Most of the students were working at their group tables, and I was moving between two groups when I noticed the image that Elice was colour cycling to produce an animation effect. I called across the room and asked her to move to one side so that everyone could see what was happening on the screen. Everyone stopped work to look. Many students called appreciative comments, and then everyone returned to work. Attention given to the work of individual students at the computers proved not to be a distraction but was instead an enhancement of classroom activities.

The thoughtful assessments, value judgements, and decisions made by the students in relation to regular classroom work and time spent in computer use showed the capabilities of the students for development of problem solving strategies and the extent to which they were able to accept responsibility for their own learning.

Operation of Computer Hardware and Software

Operational skills required by the students for use of the computers as creative media needed to be addressed. Word processed poetry required that the students' keyboarding skills be sufficiently developed so that concentration could be directed to composition of the poetry as opposed to the mechanical skill of keyboarding. Operation of the art and music software required skill in the manipulation of the device known as a mouse.

Several times during the first month of the study, I offered both individuals and groups of students the word processing software disk to use with the computers. Although 27 students had claimed previous experience in use of computers, only three students exhibited knowledge of the most fundamental operations of a computer which included how to switch power on and off and how to load and quit programs. The first time I gave the students the cardboard models of a keyboard, I realized that the instruction in keyboarding that had been claimed by 20 students had not resulted in any degree of facility that could be applied immediately to word processing. Many students knew the position of the home row keys but could not remember correct finger placement.

An initial task was thus to provide instruction in basic functional operation of computers and programs, care of the hardware and software, and keyboarding skills. Short, almost daily lessons directed to the development of keyboarding skills enabled all students to become familiar with basic computer hardware and software operation. Keyboarding skills developed to a level at which their application to simple word processing was feasible by the end of the first school term.

Most students initially displayed a tendency to jab forcefully at keys on the computer keyboards. I could not understand the reason for this tendency until I noticed students from another class using computer keyboards in a similar manner. These students were involved in game playing situations in which the speed needed to depress a key appeared to encourage forceful use. Most of my own students had claimed game playing as their only previous use of computers. I concluded that such experiences were probably the source of the unnecessarily rough treatment of the keyboards that I had observed in my own classroom. Students involved in this study gradually eliminated their tendencies to forceful depression of the keys and developed a touch more appropriate to keyboarding.

I introduced the training disk that provided practice in mouse controlled interface with software programs

at the beginning of the second school term. Students experienced no difficulties in use of the mouse which translated movements made on a horizontal plane into actions displayed on a vertical screen. I designated the first tutorial on the training disk mandatory for all students. This first tutorial provided practice in mouse manipulation through game type activities and was completed by all students within four days. After a student had completed the first tutorial, he or she was free to select any of the other nine tutorials. The tutorial most often chosen was the one that introduced computer graphics capabilities. Many students chose to experiment with the very limited possibilities of the graphics tutorial several times. Other tutorials were looked at briefly and rejected. The graphics tutorial was repeated. Students even devised a way to manipulate the program so that they arrived quickly at the section that allowed them to use the drawing and painting tools. I could not discover who had devised the short cut nor exactly how the information was dispersed, but all students seemed to know and use the method. This was a typical example of the way in which information and ideas were disseminated when students began to use the art and music programs.

When the training disk had been in use for only four days, Brent created a design composed of coloured rectangles. Other students admired and became quite excited about the design that Brent had produced, and he allowed several of his peers to attempt similar designs during his scheduled time. I decided that the students were ready for introduction of the art and music software programs. From that time on, the technical and skill aspects of computer use were secondary to use of the computers as creative media.

Students seemed intuitively able to interpret the purpose of most menu items and were able to relate the effects achieved to the actions that caused them. I answered questions or prompted the students to find their own answers whenever I was asked about such things as the difference between files and folders and what would happen if a certain menu item were selected. Information that the students considered interesting or important spread quickly.

The free exploration approach that I used only once produced disastrous results. The contents of a word processed data disk were deleted a few days before the date on which we had planned to borrow the office computer and printer and begin publication of our booklet of thoughts. I told the students who were affected by the deletion of the data that I had no solution and didn't know what to do. Every student voluntarily decided to word process a new contribution to the planned publication and did so within three days. The work was accomplished primarily in out-of-class time and without a single complaint. I inferred from this incident that the

students were confident about their abilities to both compose and word process a piece of work. The accidental erasure of a disk had also provided an opportunity for individual students to demonstrate their commitment to a class project. The full commitment that was shown at this time was also obvious in the final months of the study when the students prepared their computer poetry, art, and music for presentation.

Word Processed Work

The word processing software that was used throughout this study was of a most basic type. All standard symbols, numbers, and upper and lower case letters were available but in only one font, style, size, and colour. Text underlining was not displayed on the screen but could be obtained in printed copies by typing back slash symbols at both ends of a section intended to be underlined. The program proved acceptable for the purpose of keyboard practice and adequate for word processed passages of prose. The extent to which the limited capabilities of the program could be used in many creative ways was demonstrated by the students when they began to use the word processing program to compose poetry.

The ease with which students were able to word process depended greatly on their keyboarding skills. All students attained at least a minimum proficiency that enabled them to adequately word process the projects undertaken during the school year, but, as would be expected in any heterogeneous group of students, the skill levels varied considerably. The 10 students who, at the end of the school year, expressed a preference for use of notebooks instead of computers for general draft writing all gave as reason for the preference that their keyboarding speed was not yet as fast as their handwriting.

Students who expressed a preference for word processing were those who had developed some speed in keyboarding. One girl proudly told me, "I know where all the keys are." The delete function was appreciated by a boy who explained, "You don't have to waste erasers." Another boy admitted that he found keyboarding harder than handwriting, but he preferred to word process because, as he explained, "You can invent more."

I noticed the first inventive experiment during the time the students were preparing the prose selections of their thoughts for presentation. Beneath two short sentences that occupied two printed lines, a boy had used three times as much space for the diagonal arrangement of his first and last names.

The students eventually revealed many inventive ways in which the word processing program could be used in the composition of poetry and demonstrated its value as a means that enabled creativity. However, use

of the program had positive effects on other aspects of the students' written expression. The monitor screen displayed work that was being produced in a highly legible manner. A boy compared the writing in his notebook to the screen display and observed, "The computer always gets good printing." The legible display of work allowed individual students to realize the import of arrangement of work on a printed page and promoted accuracy and clarity in matters as simple as the beginning capitals and final periods of sentences. I observed one boy save a draft poem to disk and, before he started work on a different poem, type a sentence that I had requested he repeat in his notebook earlier that day. Unlike his previous attempts which had been directed to practice of handwriting, this keyboarded version contained capital letter, period, and correct spelling.

Some work accomplished during the final three weeks of the school year clearly demonstrated that word processed work promoted use of written formalities. A school wide competition with prizes for the best essays on the topic of what it meant to be Canadian was announced. I took the opportunity thus provided to review the use and content of paragraphs in an extended piece of work. Most students developed their essays to draft stage in their notebooks, but 13 decided to word process their essays and enter the competition. From experience I knew that formal paragraphed work was seldom a strength of most grade four students, and I had only briefly touched on the matter during that school year.

Despite my concerns, I saw that the overall development and paragraph content of most essays was handled in a satisfactory manner, and then I noticed that the format of every word processed essay was similar. Every student had indented every paragraph, which was not the case for the draft essays in student notebooks, and an extra line had been left between paragraphs. I asked one of the girls whose work rarely showed indented paragraphs how she had remembered to indent in this particular piece of work, and she told me that it was easy when all you needed to do was press the tab key. Another girl, whose essay eventually placed second to a grade seven student's entry, explained that the lines left between paragraphs was so that you could tell that they were paragraphs. Nobody was able to explain how or why they had all decided on the same format.

The legibility of words displayed on a monitor screen made obvious the overuse or omission of words. Immediate editing was done. Spelling mistakes also seemed to be recognized quickly, and dictionary comparisons with words displayed on the screen were assisted because of the similar style of print used for both. Voluntary use of dictionaries was commonplace when the students were involved with word processed work.

The fact that the individual work of any student was also plainly in view and accessible to the other students as well as to me invited us all to share in decisions in regard to arrangement, editing, and proofreading of the work. The writing process system of peer group editing and proofreading of written work had been established in the classroom, but greater interest, concern, and concentration seemed to be given work displayed on the screen in comparison to that produced in notebooks. Students would often invite a peer to help edit or proofread and even welcomed the unsolicited assistance that was offered because the work was so readily available for all to see. No student at any time indicated an objection to his or her work being so openly displayed.

A typical example of unsolicited editing and the response to it was provided by two boys. One boy had five lines of a free verse poem in draft form on the screen when the other, just in passing, commented, "You've got too many *ands*." The boy writing the poem swung around and shot back, "So, suggest something." The two boys worked together and eventually eliminated three *ands* in a manner that satisfied both. They gave me a full, unsolicited, explanation of how it had been done and were obviously proud of the result.

An interesting demonstration of proofreading skills was provided as the program for the computer art and music presentation was word processed. Production of the program was initiated by the students, and several volunteered to do the actual word processing required. A girl was chosen, and I provided an alphabetical list of student names and helped her to decide on a general format for the program. I gave the other students file cards on which to write the titles of their art and music selections and watched to see what would happen.

The program was produced as a true joint effort by all students. The major problems encountered concerned how certain words were spelled. Students who were recognized as capable spellers were called in for consultation, different versions of the same word were typed and deleted, dictionaries were searched, and only once did a worried delegation approach me for help. Cary had provided the title "Edmonton Egg Spose" for his image of a cartoon like character. The title didn't look quite right, and not even a dictionary appeared able to provide a solution according to the students who sought my help. I realized that Cary's mispronunciation of the name of the football team known as the Edmonton Eskimos had actually provided the idea that had produced the definitely egg shaped character in his image. I discussed the matter with Cary and the students who had been concerned about the spelling, but we decided to retain the original title because the double meaning contained in the incorrect spelling was so appropriate. My final proofreading of the program

revealed only two minor errors.

Few examples of students' initial draft writing were saved on the data disks because work was edited, proofread, and saved in the revised form. The process was often repeated several times because students liked to load and read their work, and corrections and changes were ongoing. Students saw little reason to keep earlier versions of work that had been improved.

Word processed work appeared to provide students a dual perspective on their own writing. They were simultaneously distanced from their work by its appearance on the monitor screen and yet closely involved in their control over its appearance. The pleasure derived from the ability to control their own work gave rise to the care and enjoyment that was shown as students word processed their written work.

Poetry

The students began to compose word processed poetry at the beginning of the third school term, and selections were displayed on the banner and published in booklet form seven weeks later. After publication of the poetry, seven students continued to use the computer to write poems. From the beginning of the term, it was not uncommon for individual students to request that I schedule them an extra time slot or for others to stay after school because, as they expressed it, they had an idea for a poem in their heads. I asked one girl during my interview with her where the idea for a particular poem had come from, and she replied, "It just came into my head when I got over there [to the computers]."

I observed Ryan generate an idea for a poem while he sat in front of a computer. He had just saved a poem about his horse and cleared the screen, when the girl beside him offered the headphones so that he could listen to her music composition. Ryan listened for a minute, returned the headphones, crossed his arms, stared at the blank screen, and said, "What shall I write about next ?" He answered his question as he typed the title "Whales" in the centre of the screen. In three minutes, Ryan composed, added his name, and saved a four line poem about whales. I asked how he knew that the poem was finished and was told, "I just didn't want to say any more."

Wherever the ideas for poems came from, they came in a wide variety. The students had previously indicated agreement with the boy who had one day verbalized his discovery that "You can write a poem about anything." Other students named the topics of poems that they had read and heard, and the list ranged from a

nonsense poem about peas to a lyric poem about moonlight. Poem topics chosen for the students' own compositions included family, friends, pets, animals in general, snakes in particular, the weather, their homes, the natural world around them, money, and many other matters that they considered interesting or important.

The students initially approached poetry composition at the computers in styles similar to those in which they approached draft poetry writing in their notebooks. I considered, from years of experience as a teacher of grade four students, that the approaches and styles used by these students were typical for children of their ages.

Several students had already developed an understanding of rhythmic phrasing, selection of vocabulary, and presentation formats of traditional poetry. Stephen was one of these students, and he drew on memories of the place where he formerly had lived to word process his first poem.

The Yukon

Its not too warm or too cold,
But lots of gold,
With northern lights.
Plenty of towns,
Very few cities,
Covering the Yukon's mother loads.

Many fire weed plants,
Very few flowers covering the Yukon's land.

Stephen Muff

Greg also demonstrated through work in his notebook that he wanted to write poetry in lines, but his attempts had resulted in unintentionally staggered lines that provided no unified appearance to his work. I observed him gain control over the appearance of his work as he composed his short poem about winter.

Winter

Winter is kids
Playing in the snow
Lights in kids' eyes
The town is
Full of snow.

BY GREG CARSON

Greg had composed this poem in his head and previously had recited several different versions to me.

He knew what he wanted to write before he went to the computer. Greg began by typing his poem in lines which all appeared to the far left of the screen. The result was obviously not satisfactory because he cleared the screen. For his second attempt, he used the tab key to position the cursor to the left of centre screen and typed the title which appeared on the screen well centred. He estimated the beginning of his first line as one less tab than the title. The position of the first line obviously met with his approval, and he continued to align his poem by use of the tab key. When Greg looked at the poem, the lights in his eyes clearly indicated that the poem finally appeared the way he had intended it should. He asked my opinion about the lowercase letters that he had used to begin all but the first line of the poem. He wondered if capitals would look better. I told him that I'd seen poems that had been presented both ways and suggested he try capitals and then decide for himself. The final version made use of capitals to begin each line and gained a line of minus signs that provided an underline for the title.

A few students still did not differentiate prose and poetry. Timothy's first attempt to write a poem about his dog resulted in continuous lines of prose. He looked disgustedly at the screen and said, "That doesn't look like a poem." A boy who overheard his comment agreed and suggested that the words be put in lines. Timothy accepted the boy's help and was satisfied with the finished appearance of his poem.

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    WHY I LOVE MY DOG
My dog Jesse is nice to me.
She walks me down to the bus stop,
She goes hiking with me.
She goes fishing and swimming with me too.
That's why I love my dog.

                    Timothy Thorpe
```

Several students experimented with the effects produced when lines of poetry were staggered. Trevor's poem about turtles provided an example of the purposeful use of staggered lines. Trevor began his poem by typing a few ideas about turtles and subsequently developed those ideas into his finished poem. He systematically saved the work accomplished during each session at the computer and thus provided a way to see how his initial ideas developed into the finished work.

Draft 1 contained the thought that provided the metaphor used for the poem.

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Tritles forlaged thay got litle padrins on there tumeas
It looks like thave bin in the armea
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Draft 2 began to develop the metaphor suggested in draft 1. Indications that Trevor wanted to use his ideas to form a poem were evident. The work was given a title, and a presentation format was explored through experimentation in the use of upper case letters and staggered lines.

A TURTIL

TURTILS IN THEAR GREEN ARMER BLOOING
DOWN THE BUG FORCE
AND THEN THAY GO IN TO THE WATER LIKE LITTLE SUBS
AND OUT AGANE LIKE TANKES

Draft 3 added action details and omitted the visual aspect of the turtles' green armour. Use of a symbol key in regular and shift positions received experimentation. Trevor added his name to this version which suggested that he considered the poem near to completion.

Army tritls blooing down the bug force
Than in to the walter like litle subs blooing up the beatle force
Than ought like litle taks
than thay get to there base the log

BY:TREVOR SCOTT KNOL

Draft 4 became the finished version of the poem. Neither the expression nor the arrangement of the fourth draft was changed when the final proofreading that corrected the spelling was done.

ARMY TURTLES

Army turtles blowing down the bug force
Then into the water like little subs blowing up the beetle force
Then out like little tanks
They get to their base
The log

BY:TREVOR SCOTT KNOL

The uniform appearance of work displayed on monitor screens drew attention to repeated words or phrases. Undesirable overuse of words or phrases was recognized quickly and deletions or substitutions were made. The repetition of a single verb became obvious to Kristelle when she looked at the first draft of her poem.

THE CAT

The cat prawls
The cat prawls at night
The cat prawls again

By Kristelle Jaschke

I had been working with individual students in the classroom and had stopped as I was passing to read Kristelle's work. She turned around, looked up inquiringly, and inflected a statement into a question, "I've got too many *prowls* ?" I suggested that she might try to think of other ways to describe how her cat moved and then went to check the work of another student. Within several minutes she asked me to come and look at her revised version which she had typed below the original. After I had read the poem, I told her the accepted spelling of *prowls*. Kristelle quickly corrected the word, and the poem was ready to be printed.

CATS

The cats prowl at night
Cats walk in the dark moon light
The cats tiptoe gently

By Kristelle Jaschke

Recognition of the effects of repetitions sometimes resulted in their purposeful use. Lori wrote three poems on three distinctly different topics in which she used conscious repetition of phrases to emphasize her meaning. The loneliness of a solitary weed was stressed through repetition in one of Lori's poems.

DANDELION

Sitting away from the rest
Poor little dandelion cold.
He sits alone.
Poor little dandelion
Poor little dandelion.

BY LORI EIDSNESS

Another form of repetition resulted in the series of poems that were written by Sheri. Her poems were about nature, animals, or birds. Each poem contained a single use of the word *joyful* or a closely related form

of that word. A simile was also used in her poem about clouds.

Clouds

Clouds look like big butterflies
Flying in deep blue sky.
Flying
Joyfully.

By Sheri Howell

I saw the first departures from traditional format in several poems written about snakes. The exact column alignment that was possible in word processed work enabled several students to make their poems look like snakes. Tyler went to the school library to research the facts that he presented in his snake poem.

THE SNAKE POEM

THE PYTHON IS THE BIGGEST SNAKE IN
T
H
E
WORLD
T
H
E
N
COMES
T
H
E
ANACONDA
A
N
D
BOA

TYLER ORME

Students continued to compose traditional types of poems, but I noted increased experimentation with poems that were expressed through the arrangement of words. Some experiments produced results that students considered unsatisfactory. Carmen was disappointed that a vertically printed word around which she had constructed her animal poem was not obvious to the reader.

ANIMALS

Animals eating.
Babie aNimals Eating.
Babie bIrds Eating.
Mother birds searching for food.
People wAtching animals.
Lamas sounding their horns.
Birds Singing.

Carmen decided not to continue work on her animal poem and began to write a poem about frogs. She told me that the first draft of her frog poem had been arranged in lines of single words until someone had said, "Why don't you make it look like a frog ?" The manner in which Carmen then arranged the words of her poem met with approval from several of her classmates who insisted that I immediately look. Before I was close enough to the screen to read the words, I saw that the arrangement effectively suggested a frog.

FROG
Frog
Spots Warts
Slimy
Yucky Wet
Burrp
S S
p p
l l
a a
s s
h h

Carmen Huseby

Sarah was disappointed by her attempt to arrange the words of a poem into a raindrop shape. She explained that she couldn't use the words she wanted and still make the poem look like a raindrop. I considered that the manner in which she had spaced the second line was a possible solution, but Sarah was frustrated by the conflict between word choice and visual presentation and did not resolve her problem.

Drops
D r i p s
Diamonds and
gems.They look
like gems in the
sparkling sunshine
of dawn.

Sarah Fassman

The next poem that Sarah wrote did not focus on visual presentation but demonstrated the importance that she placed on the choice of words used in a poem. The inverted repetition of the middle section was not only descriptive but was preparation for the placid mood of acceptance expressed in the final line.

SAND

Sand
Shore
Coming and going
going and coming
going on the muddy shore.
I guess that's the way it is!!

By Sarah Fassman

I had not formally taught the use of any poetic devices that the students used in their poetry writing. Many devices had been encountered in poems we had read, and we had discussed them in relation to the effects that were achieved. I sometimes mentioned a formal term, but the only term I later heard the students use was *alliteration.* They enjoyed the sound of the word, used it often, and demonstrated in written and oral work that they knew its meaning. Amanda's poem about a snake made use of alliteration and suggested the shape of a snake through the arrangement of the lines.

Snake Poem

slither scaly
sliding snoopy
flash it's gone
swampy smelly
poisonous
wriggly ugly
go away

by Amanda Hackman

Serena faced a problem similar to the one experienced by Sarah when she also tried to write her poem in the shape of a raindrop. A compromise solution had been reached. Serena had used the vocabulary she wanted but had split the words in order to create the raindrop shape. She told me that she liked the poem, but the fact that she had not proofread and printed it over a week later when the deadline day for contributions to the poetry banner arrived suggested to me that Serena was not completely satisfied with her poem.

Bukets
of water
make me dr
owsy rain d
rops make me d
rowsy everything
that falls from th
e ski that makes
me wet makes me
DROWSY.

During the morning of the day that had been designated as deadline for publication, Serena requested a time slot at the extra computer, loaded her raindrop poem, looked at it for a while, and then said, "It doesn't work. It's broken up." I asked her what she was going to do and she replied, "Change it." She obviously had an idea, so I left her alone. When I checked back about 10 minutes later, I saw that Serena had relinquished the idea of presenting the poem in the shape of a raindrop and had found an arrangement that emphasized the meaning of the words and the mood of the poem. As the rewrite progressed, the original version scrolled out of sight. The careful reference that Serena made to the original as she typed her new version became difficult, and Serena showed signs of exasperation. I realized that she considered her choice of words for this poem to be a most important aspect and suggested that she print a copy of the first version to use as reference. Serena named the poem and confirmed the assumption I had made about the importance to her of the words she had chosen. Rearrangement of the words had changed a poem about raindrops into a poem about drowsiness. Serena expressed satisfaction with the finished work in the comment she made as she watched her poem roll out of the printer, "Now it says what I want."

D-R-O-W-S-Y

B u c k e t s
o f - w a t e r
m a k e - m e
d r o w s y - r a i n
d r o p s - m a k e
m e - d r o w s y
e v e r y t h i n g
t h a t - f a l l s
f r o m - t h e
s k y - t h a t
m a k e s - m e
w e t - m a k e s
m e - d r o w s y

By Serena Unger

Carrie provided an example of how the same theme could be presented in two different ways. The first poem about her messy room was presented in a traditional format. The use of ellipsis points to indicate breaks in thought and incomplete statements may have been in imitation of some printed material that Carrie had read or intuitive experimentation. I had not mentioned the use of such punctuation during the time Carrie had been in my class.

MY MESSY ROOM

My mother says "clean your room!"
I say "if I clean my room I won't know,
Where anything is," but my mother says.....
" Clean your room and I don't care!"
So I had to clean my room.....
The next day..... " mom! I can't find..... "

Carrie Williamson

The topic of Carrie's first poem prompted her to experiment with a version that expressed the meaning in a visual manner. The story line of her first poem was not retained, but an ending that suited the visual presentation was added. The second version was written a day after the first.

MY MESSY ROOM

I
h
a messy room.
v
e a "Clean your
room!" my Mother says.
I pretend I
don't hear her.
But.....
"Clean your room or else!"

"O.K. O.K." I said.

A a box. i
n THE END n
d I put everything

Carrie Williamson

Students experimented with word arrangements, but they also experimented with words. Tamara consciously used repetition and rhyme in a poem about bananas. She liked the sound of the poem when it was

read aloud. I first saw the poem when Tamara called me to the computer and said, "Listen to my poem." She read it to me and then repeated it several times for others who gathered to listen. Later, when she had a printed copy, I watched her read the poem aloud as she walked across the room. She moved her body and the paper from side to side as she read alternate lines. As she read the last line, she stopped and laughed. She appeared to enjoy the rhythmic phrasing of her nonsense poem.

BANANAS

BANANAS ARE SO YUMMY
BANANAS ARE SO SUNNY
BANANAS ARE SO FUNNY
BANANAS ARE IN MY TUMMY
BANANAS ARE SOMETIMES CRUMMY

I LIKE BANANAS.....BUT MY MOM DOESN'T!

BY TAMARA LUKENS

Cary played with the sound of words in a poem about a snake. The fact that he didn't try to make the poem look like a snake at a time when several other students were writing snake shaped poems indicated to me that Cary's concern was directed toward his use of words. Tyler, a student in the class and a friend of Cary, was not offended by the insinuation at the end of the poem.

THE SNAKE POEM

Ugly as a glippy gloppy gloom
gloop
glop
glip
blip
with a show
of Tyler's face
he's gone.

Cary Polanski

While the students experimented with words and the arrangement of words, they also discovered possibilities offered by the word processing software. Some of the discoveries made and used by the students may have been possible if typewriters had been provided. However, I considered that many effects discovered and used by the students in their poetry compositions were unique to computer word processed work.

The word processing program that the students used would not display underlined text on the screen. Although I explained the procedure necessary to obtain underlined text in printed copies, only four students used the method. The other students experimented with the symbols available and used various ones to underline titles, mark the end of work, or decorate their poems. The poem about money that was produced jointly by Neil and Sasha used symbols to function as an underline in a manner more lavish than was typical for most students but demonstrated the type of experimentation that foreshadowed a major development in the students' poetry writing.

```
                                 MONEY$$$$$$$$$$$$$$$$$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

                           MONEY SHINES LIKE HONEY$
                           IT SPARKLES LIKE JEWELS$
                           IT'S SO SHINY IT'S NOT FUNNY$
                           THAT'S WHY MONEY SHINES LIKE HONEY$

1,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,00
0,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000.

                             BY NEIL & SASHA THE BEST.
----------------------------------------------------------------------------
----------------------------------------------------------------------------
```

As the students explored the possibilities available in computer word processing, many began to compose in the genre of concrete poetry. The syntax of language became unimportant as semantic, visual, and phonetic elements of language were used in direct presentation of ideas. Of the 32 students who were involved in poetry composition, 15 worked in the genre of concrete poetry. Their own names were the starting points for eight of these students. Several different approaches to presentation of names were demonstrated.

Cary used letters to form the letters of his first name.

```
ccccccccccccccc
c
c                                aa                     y    y
c                              a  a                      y  y
c                             a    a                      y y
c                            a      a          rrrrrr      y
c                           aaaaaaaaaa         r          y
c                          a          a        r          y
c                         a            a       r          y
cccccccccccccccc          a              a      r          y
-----------------------------------------------------------------
```

Sasha and Neil who had both experimented with repeated lines of symbols each found a different way to present their names. Sasha used solid lines of letters.

```
SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA

PPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPPP
RRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
HHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
RRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

Neil used his both his first and last names to create the initial of his last name.

```
NEIL BOLTON N
NEIL BOLTO    E
NEIL BOLT       I
NEIL BOL          L
NEIL BO           B
NEIL B            O
NEIL              L
NEI               T
NE                O
NEIL BOLTON NEIL  N
NE                O
NEI               T
NEIL              L
NEIL B            O
NEIL BO           B
NEIL BOL          L
NEIL BOLT       I
NEIL BOLTO    E
NEIL BOLTON N

  by Neil Bolton
```

Many students experimented with patterns that began with words or phrases from which letters were then subtracted and added in a similar manner to the way in which Neil began his name poem.

Neil first typed the block on the left in which his name disappeared and reappeared. When the work had

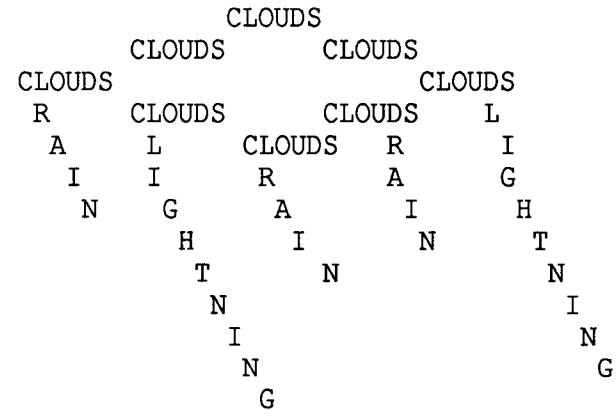
reached that stage, he seemed pleased with its appearance, but he then thought of the idea that resulted in the finished letter shape. I saw Neil type his name at the midpoint of the pattern but did not understand his reason until he moved the cursor to the top of the pattern and began to add the diagonal letters.

Brent experimented with several different arrangements for the presentation of his name. The particular arrangement of his name to form its letters required that Brent visualize and plan the placement of each letter.

```
BRENT   BRENT   BRENT   BRENTBRENT    BRENTBRENTBRENT
B   B   B   B   B       B       B         B
R   R   R   R   R       R       R         R
E   E   E   E   E       E       E         E      BY BRENT
N   N   N   N   N       N       N         N      SMOES
T   T   T   T   T       T       T         T
BRENT   BRENT   BRENT   B       B         B
B   B   B   B   B       R       R         R
R   R   R   R   R       E       E         E
E   E   E   E   E       N       N         N
N   N   N   N   N       T       T         T
T   T   T   T   T       B       B         B
BRENT   B   B   BRENT   R       R         R
```

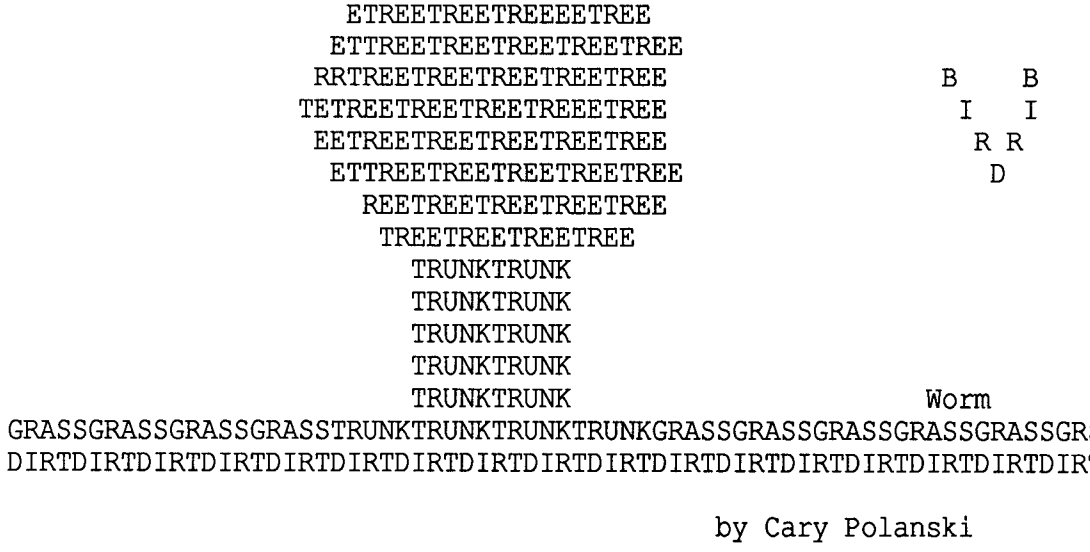
The composition of concrete poetry revealed students' associative thinking skills. The students appeared to associate and combine ideas from different areas and disciplines without concern for traditional restrictions. They approached the language symbols which are the raw material of written poetry with a freedom that allowed other possibilities for their use to be explored. One of the products of such associative thinking was incomprehensible to me as I watched its progress from the other side of the room. Sasha had enlisted the assistance of David and Jesse, and together they typed pages of repeated letters and symbols. Each chosen letter or symbol was used to fill many lines. A discussion would then result in the choice of a new letter or symbol that was again repeated for many lines. Sometimes the symbols or letters were alternated. The reason for what they had done was revealed when I was invited to press an arrow key. When the screen display scrolled the pages of letters and symbols, an animation effect was produced.

Examples of work that I more readily understood included the visual poem which was one of the earliest works of concrete poetry that was composed by a student in the class. Carrie's first draft of the poem had only rain emanating from the cloud. She later deleted some rain and added the lightning.



Carrie Williamson

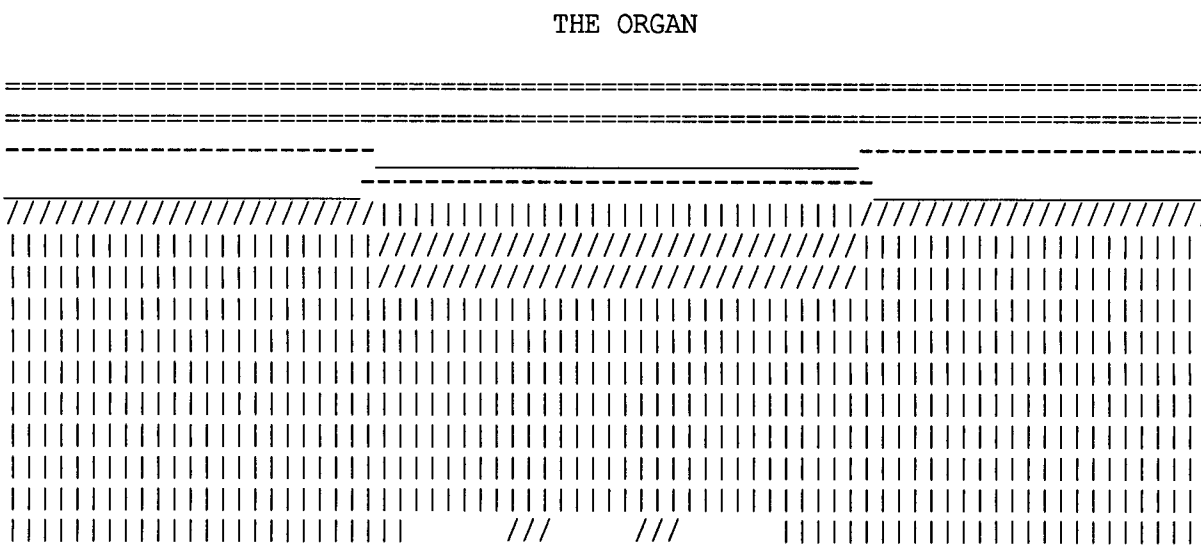
Cary produced the visual poem that he saved on his disk as "Treetrunk" during the last few weeks of the school year. He explained the origin of the idea for his composition in a manner that clearly indicated associative thinking. He said, "I was doing it on art [using the art software program], and I thought maybe I could do it on the word processing, so I tried."



by Cary Polanski

The students used the computer word processing program in many creative and inventive ways. My realization and understanding of the possibilities for its use increased as I saw the work produced by the students during the first few weeks that they word processed poetry. An indication of the extent of the creative possibilities provided by the word processing software was demonstrated when Ryan created "The Organ." I first saw the work when it was almost complete. A boy, with eyes wide open and urgency in his tone of voice,

had requested that I "Come and look at what Ryan's done." I joined a group of students who had gathered behind Ryan and watched while he completed the work. The students had been quiet while Ryan worked but, as he finished, they made colloquial comments that indicated approval. Ryan shrugged his shoulders in acceptance of the peer approval but was unwilling or unable to comment on his own work. He continued to stare at the screen for a while, his head slightly to one side, before he added his name. I felt that he was impressed by the realization of his idea that was now displayed on the screen.



Ryan Ingersoll

Christine and Sasha continued to explore creative possibilities of the word processing software into the last week of the school year. I heard them discuss how one particular idea might best be presented. No agreement was reached, so they each produced their own version of the topic.

```
   LOLLY
  LOLLY LOLLY
LOLLY LOLLY LOLLY
  LOLLY LOLLY
   LOLLY
     P
     O
     P
     O
     P
     O
     P
```

Christine Smith

```
    CANDY
  CANDY CANDY
CANDY CANDY CANDY
  CANDY CANDY
    CANDY
      S
      T
      I
      C
      K
```

Sasha Prohoroff

Traditional forms of poetry were also composed by other students during the last few weeks of the school year. A second Tamara in the group wrote about her horse, and Sheri continued to compose joyful poems about animals. Greg, still with lights in his eyes, composed short free verse poems about many things important to him: camping, hunting, and his longest poem of the year about what it meant to him to be a Canadian.

Christine's final poem of the school year was a visual work that caused me to wonder what further developments might have occurred if it had been possible to continue the study. She titled her work "Notes."

```
    NNNNNNNNNNNNNNNNNNNNNNN                  N
    N                     N                  N N
    NNNNNNNNNNNNNNNNNNNNNNN                  N   N
    N                     N                  N     N
    N                     N                  N
    N                     N                  N
    N                     N                  N
    N                     N                 NNN
   NNN                   NNN               NNNNN
  NNNNN                 NNNNN             NNNNNNN
 NNNNNNN               NNNNNNN             NNNNN
  NNNNN                 NNNNN               NNN
   NNN                   NNN


NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNN
OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO
TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT
EEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE
SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS

                                             by Christine Smith
```

During my interviews with the students, several described future computer projects that they would like to undertake in terms that indicated disregard for traditional boundaries that are often perceived between disciplines. The associative thinking skills that permitted the combination of ideas and concepts from various areas were evident in several descriptions of future projects. All such project descriptions involved use of the art software program. Cary wanted to write a poem about summer. Neil wanted to type his name and make a picture out of it. Sasha described to me a method he had devised to write music notes with the drawing tools available on the art program. He wanted to try a music composition that used his devised notation. Kristelle had an example of origami work that she wanted to represent, and Tamara thought that she would "maybe try

and draw a computer."

The students received 21 written responses to their poetry booklet: twelve from parents, eight from other teachers in the school, and one with a legible adult signature from someone whose name was unfamiliar to all. The last mentioned response was on my desk one morning and stated in two short sentences that imagination and the poems were "wonderful."

Reader responses supported my opinion that the students had used a wide variety of styles and poetic devices. Enjoyment of the poetry was generally expressed, and many respondents commented specifically on the aspects they had most enjoyed. Mention was made of the haiku and visual forms, the animal and nature themes, the use of imagery, and the use of words whose sound suggested the sense of the poem. The thoughtfulness, imagination, creativity, and originality demonstrated by the poems also received many comments.

Two responses from members of school staff indicated that the students' poetry had stimulated reciprocal creativity. One was written in free verse and the other used visual arrangement of words.

I considered that the students had shown exceptional commitment to the writing and presentation of their poetry, and this commitment was recognized by the teacher who commented on the "excellent combined effort" of the group in production of the poetry booklet.

Several students from the school's other grade four class commented about the poetry banner that was displayed in the hallway. They claimed that every time they looked they found new poems or better understood the meaning of a previously read poem. They also expressed the thought that much time and effort must have been required to write the poems at computers.

Only four adult respondents mentioned the use of computers in relation to the writing of the poetry, although I had included in the poetry booklet a brief description of the hardware and software that had been used. These respondents were amazed and impressed that "mechanical technology" had been used so effectively in "such an abstract and creative matter as poetry."

I personally was impressed but not amazed. I had been in a position to observe and understand that the use of the word processing capabilities of computers had stimulated the diverse collection of poetry written by students who had displayed self-motivation and delight in its composition.

Art

In comparison to word processing and music, the art software program was specifically mentioned by 17 students to be their favourite. These preferences expressed during my interviews with the students were consistent with my observations and reflected the greater interest and development in art that had been revealed through the initial fine arts survey.

When I introduced the art program, I suggested that students refer to the cards on which I had identified and given brief instructions for activation of the various tools. The sequence of tools displayed on the vertical menu had decided the order in which the cards were numbered. The cards introduced freehand lines of varying thickness, straight and curved lines, colour fills of shapes, the airbrush, geometric shapes both filled and in outline, and then the more advanced tools.

I initially accepted that the order of presentation of the tools accounted for the students' early work with the art program but later realized that the manner in which the tools had been used revealed definite stages in development that had been supported by the order of presentation of the tools.

Most students first tried every size of brush and every colour as they made scribble patterns that were frequently cleared from the screen. The thick brushes were used most often and the brushes that drew dotted instead of solid lines were also popular. The dotted line brushes were quickly termed *paint sprinklers* by the students. After initial experimentation, most students attempted a freehand drawing of a human figure or face, a tree, or an animal.

During the day on which I introduced the art program, Kenneth drew a duck. A girl who watched him commented, "It seems like you're drawing right on a piece of paper." Kenneth then attempted to fill the outline of the duck in the manner in which a crayon would be used. He did not appear pleased with the result, so I suggested that he use the fill tool. He did so, and his excited response, "This is better than drawing on paper," expressed an opinion that was later echoed by many of his peers.

The same day, during lunch break, a group of six students watched Carrie experiment with the straight line tool. A brief incident occurred that proved to be an example of the type of oral language development, fluent thinking, and group acceptance that was recurrent and commonplace when students worked with the art program. Carrie drew, and the four boys and three girls who watched commented. The incident happened quickly, and I considered that the visual and verbal events were intermingled, and one was not dependent on, or

leading, the other.

Carrie drew two parallel horizontal lines and added coloured dots between.

Someone said, "It's a road."

Another added, "And cars."

A third student advised, "Make the road white."

Other comments that concerned cars and roads overlapped these comments and the continuous drawing done by Carrie.

Carrie added two parallel vertical lines that crossed the first two and then added more dots.

As she drew, the comments continued and overlapped as before.

"Lots of cars."

"Make sharp corners."

"It's a traffic jam."

"Little men with life jackets floating down a river."

"Shipwreck."

"Make the lines blue."

Carrie filled the background, not the lines, with blue.

"It's a boat."

"On the lake."

Carrie drew diagonal lines from the top vertical arms of the cross. They were all laughing as Carrie cleared the screen.

A simple diagram had developed and been given meaning by a group of students who had used each other's ideas as springboards for their own. The diagram had been interpreted from a bird's-eye view in two different ways and then its perspective had been changed to a side view. All students in the group were fully involved in their jointly created changing image and accepted and built on the ideas put forward by others.

The speed with which the incident took place caused me to wonder if any medium other than the computer could have promoted, or kept pace with, the rapid stream of consciousness style of creative fluency that was demonstrated by this group of students.

I heard comments that began "It looks like . . ." often when students used or watched others work with

the computer art program. One afternoon, all the students were in spectator positions as I gave a short demonstration on how to use the drag technique to make a brush that painted with a section of an image. I selected a section of randomly drawn spheres and used the brush that was created to draw a freehand line. Immediately, students began to interpret what they saw. Different students called out, "It's an eye," "It's a worm," "It's a dragon," and others began to elaborate the ideas into stories.

Such association of ideas with random experimentation often provided ideas for image making. One day in mid winter, Stephen randomly drew some curving purple lines across a white screen. He became more alert in manner, selected the airbrush tool, sprayed green dots on the lower portion of the screen, turned to me and said, "That's how it is at our house." His remark allowed me to see the purple mountains and a few grass blades that showed through the snow.

Interpretation of work in progress was also made even when no desire was shown to use the ideas that were generated in a composition. Ryan worked on the design shown in Figure 2 after class one day. His younger sister, who was in grade one, watched as he worked. He completed the background of overlapped rectangles, drew the three ellipsis at the top of the image, and commented, "It's an eye." He paused and added, "It looks like an Indian mask." He then added the three groups of circles and said, "Olives." The last thought led to the addition of three slim triangles to the right centre of the image and the comment, "Three toothpicks." He sat back, looked at his toothpicks, and remarked, "I made it into an *H*." The three toothpicks formed the shape of the letter. His sister, who had been silent up to this time, chose to disagree. "An *I*", she said firmly. Ryan saw her point of view and agreed that it was an *H* one way and an *I* the other way. He then decided that he didn't like the toothpicks in his design, and their removal provided Ryan with a complicated exercise in problem solving.

The constant desire to interpret, give meaning to, or associate ideas with images that were produced allowed the later creation of nonrepresentational works that were not designs but abstract art. However, much experimentation was done before the stage of abstract art was reached.

Many students used freehand lines, circles, curves, and dots to draw animals, trees, human figures, and many different faces. Discovery of the tool that would fill shapes with colour and the tools that drew geometric shapes in either outline or solid colours generally halted attempts at schematic and representational work. Full page designs of coloured shapes that were covered in spots by use of the airbrush tool became favourite

creations. A typical image that was produced at this stage is shown in Figure 3.

Figure 2. "Ryan 3" by Ryan Ingersoll. Geometric design that used default palette colours.

Figure 3. "Kenneth 2" by Kenneth Hemminger. Colour filled shapes that were airbrush sprayed.

Students also discovered the capability of the computer to cycle colours in their palette sequence when the tab key was pressed. They enjoyed the animation effect that was produced and constantly used this feature. The colour cycling feature of the art program probably initiated the scrolling of the word processed symbols to produce an animation effect when the students worked on poetry composition.

I noted three distinct recurring stages in the use of each new aspect, feature, or function of the art program. Each newly discovered item would first be used randomly. An attempt would then be made to control the new discovery and to explore its possibilities. Such an attempt often resulted in some patterned use. Finally, the discovery would be used consciously to create an image. These three steps often happened consecutively within the space of a few minutes. Kristelle clearly demonstrated the three steps when she first used the symmetry tool and created the snowflake pattern shown in Figure 4.

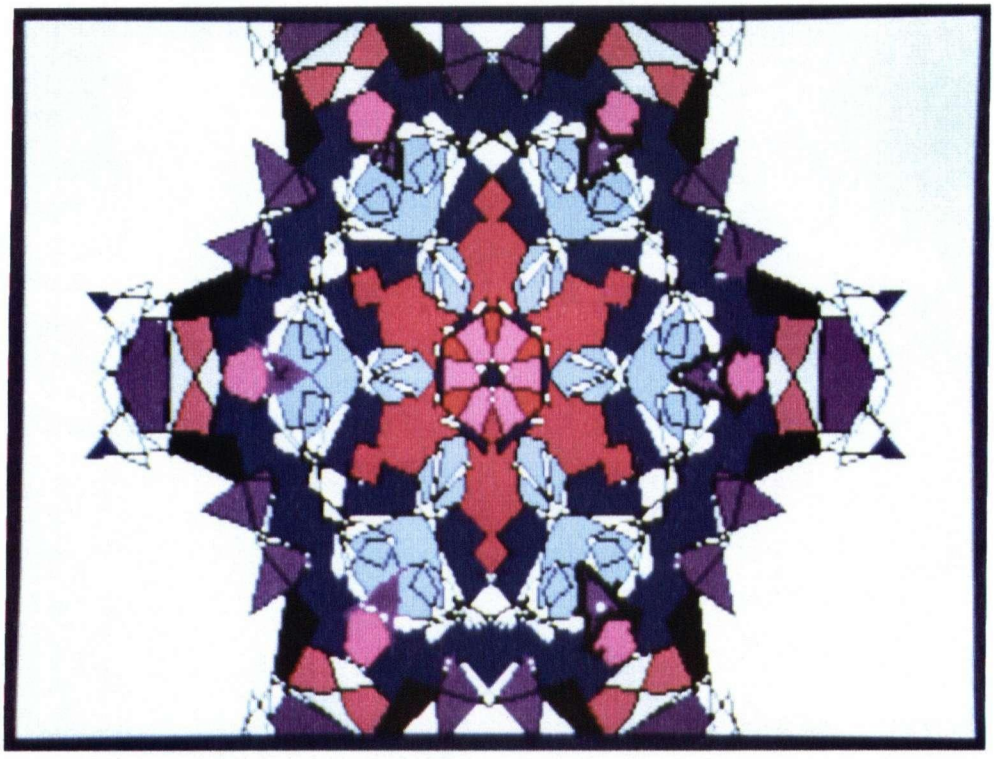


Figure 4. "Snowflake Shapes" by Kristelle Jaschke. Use of symmetry tool.

Kristelle selected the symmetry tool for the first time and drew randomly. Each line was mirrored and repeated at five other places around a central point. The randomly drawn lines quickly produced a screen full of crossed lines and curves. She cleared the screen, then moved the brush slowly in different directions, and

carefully watched the result of each move. Again she cleared the screen, selected a different colour, and this time watched the drawing point of the brush as it moved. At one time, she traced a finger across the screen before she moved the brush to draw the line she had traced. The design now resembled a snowflake. From the tip of one point she drew a curve that resulted in a closed oval shape at the end of each point. She selected the fill tool and a different colour and filled one of the oval shapes. Because she was using the symmetry tool, all six ovals filled. She filled another enclosed shape, and then another, and noted the same effect. She smiled and cleared the screen. Her next drawing was a consciously controlled selection of shapes and colours that produced the design shown in Figure 4.

The students had become proficient in the use of the basic features of the art program and were exploring more complex aspects before reflection suggested that another set of developmental stages had occurred. There were indications that students, in use of the new computer medium, had regressed to the earliest developmental stage of scribbling and progressed rapidly through each subsequent stage to their present level.

At the beginning of the third school term, a new boy registered in my class, and I was able to confirm what I had generally observed in the development of the other students by observation of his initial approaches to art work that used computer as medium. Vernie first tried every colour presented by the palette and scribbled in both circle and line patterns. He cleared the screen frequently.

The next day, Vernie experimented with the straight line tool. He drew a diagonal blue line and crossed it with a second to form a diagonal cross. In another place on the screen, he drew a perpendicular cross. He then started from the centre of this cross and added a line between two others. He continued to work from the centre point until he had completed a radial pattern. He then selected red and, from the centre, drew a red line beside every blue line in his radial pattern. Vernie cleared the screen and drew two parallel lines which he crossed with three separated diagonal lines. To one of these diagonals he added lines to form a radial pattern.

Vernie's third session with the computer art program was used to draw faces and a tree. Each representation was an isolated unit. No attempt was made to relate objects to each other in any form of pictorial representation. Vernie then discovered how to use the fill tool and the tools that formed geometric shapes, and all his subsequent work was nonrepresentational.

Vernie had clearly demonstrated a rapid progression through well recognized stages of art development: scribbling, diagram combinations, and schematic representations. He then moved into a stage of

nonrepresentational work as opposed to the expected stage of increased realism. The developmental progression that Vernie demonstrated was the same that I had retrospectively observed in the work of the other students.

Every student created nonrepresentational work, and only some also produced representational images. Realistic work that was produced by the students displayed characteristics that were usual for children of their ages: schematic suns, base lines, beginning placement of overlapping objects on a plane, and detailing of objects. The style of representational images changed as the students learned to work with the special characteristics of the computer medium.

Initial realistic image making used the computer medium as a substitute for crayons or paints. A typical image that used the medium in this manner is the one shown in Figure 5. Tamara drew each element freehand, although the outlines were filled with colour by use of the fill feature available through the computer art program.

Figure 5. "A Sunny Day" by Tamara Lukens.
Representational image that used computer medium as substitute for crayons or paint.

The realistic image that is shown in Figure 6 used techniques that were dependent on the computer

medium. The image titled "Tennis Court," created by nine year old Carrie, displays many of the characteristics expected in realistic work produced by children of her age. A base line is implied, but all elements are against a background that was produced through use of a pattern fill technique made available by the computer. Detailing is obvious in the features and clothing of the players, but they are mirror images because the second player was created by a brush rotation technique possible through the computer medium. One tennis ball that was created as a brush was repeatedly stamped to represent the continuous action of the game. This representation is an example of the fusion of time and space that is sometimes demonstrated by children of Carrie's age.

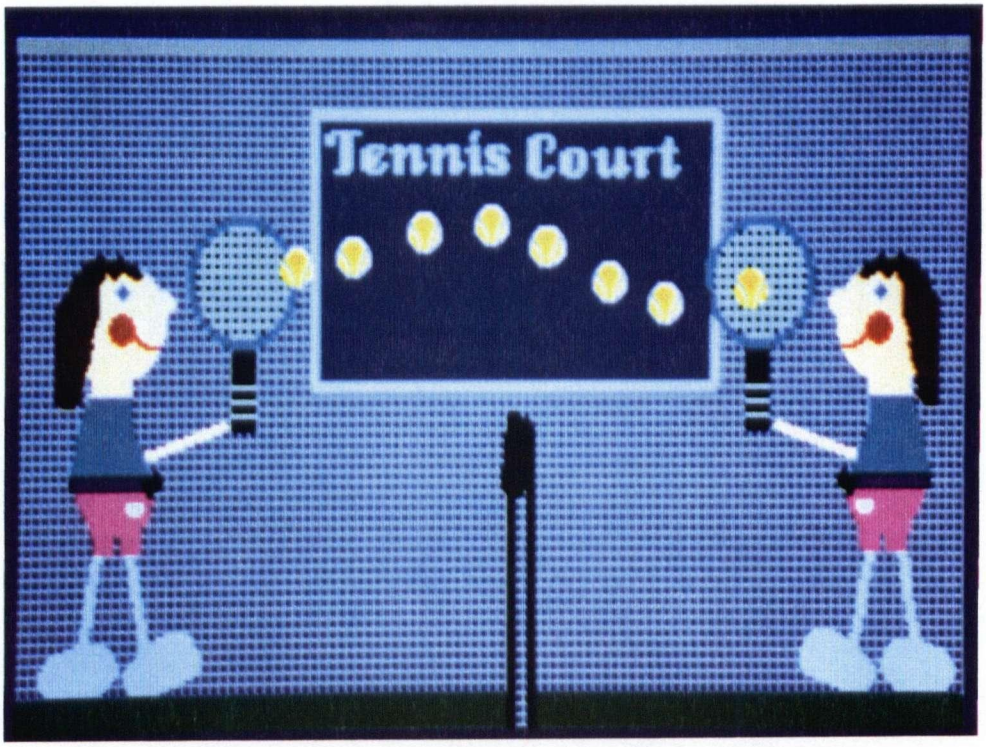


Figure 6. "Tennis Court" by Carrie Williamson.
Representational image that used techniques dependent on computer medium.

Realistic image making displayed characteristics typical of the work of nine and ten year old children. However, the students reviewed all previous developmental stages in image making, including scribbling, before they produced the type of realistic work that could be expected from children of their ages. This occurrence could be accepted as a natural progression in the exploration of the computer as a new creative medium for art. The order of introduction of the drawing and painting tools actually supported such progression. However, the general abandonment by the students of realistic work in favour of

nonrepresentational was an aspect that had not been given consideration in documentation of the developmental stages in children's art. Kellogg (1970), Lansing (1976), and Lowenfeld and Brittain (1982) did not discuss such nonrepresentational development but indicated continued development toward realism and naturalist representation in children's art work.

The development of nonrepresentational work by the students as they used computer as medium appeared to have a positive effect on the level of confidence displayed by students in relation to their abilities to create personally satisfying images. Not once did any student, in relation to computer art, express the opinion that he or she could not draw. A girl looked at a sketch in her notebook and confided that she couldn't draw horses very well, but she never tried to draw horses when she used the computer as her creative medium.

The students created images that gave pleasure to the artist and to those who saw the work. The intent of the images was attentive perception and aesthetic experience which Lansing (1976) described as the requirements for works of art as opposed to works of nonart. Most of the works of art were nonrepresentational and pleasing in their balance, unity, and use of shape and colour. Students who were confident in their talent for naturalistic expression worked primarily in realistic style, but the other students worked primarily in nonrepresentational style. Included in the small group of students whose images were mainly representational was the girl who had been perceived by herself and peers to be the student in the class most oriented toward fine arts.

Selective use of colour by the students became obvious because the computer provided over 4000 different colours. Kellogg (1970) explained that she gave no consideration to the use of colour by children because their choice was limited to those colours made available to them by adults in such media as crayons or paints. The computer, however, gave access to subtle tints and shades of every hue that, unlike mixed paint colours, did not combine to produce unwanted effects.

The 16 default colours of the art software palette were a spectrum of saturated, distinctive colours plus black and white. Students were satisfied to work with these default colours until they discovered the choices available to them and thereafter took considerable time to mix and select a palette of colours of their own choice. Selection of colours was seen to be important to the students. Kristelle demonstrated a typical example of the importance of colour choice on the day she used her 20 minutes of scheduled time to create a palette of blues and pinks. At the end of her time, she saved a small brush that used her palette and remarked, "I'll use them

[the colours] next time."

The initial colour palettes created by the students were selections of distinctly different colours such as the palette used by Amanda in the image shown in Figure 7. Variations of turquoise and crimson were colours often mixed and used by many students. Four girls watched Amanda produce the image. When she had finished, one girl suggested that she change to the default palette to see how the design would look in different colours. Amanda did so, and there were cries of, "Yuk!", "Ugh!", and "Quick, restore it." Loud sighs of relief met the reappearance of the design in Amanda's chosen colours.

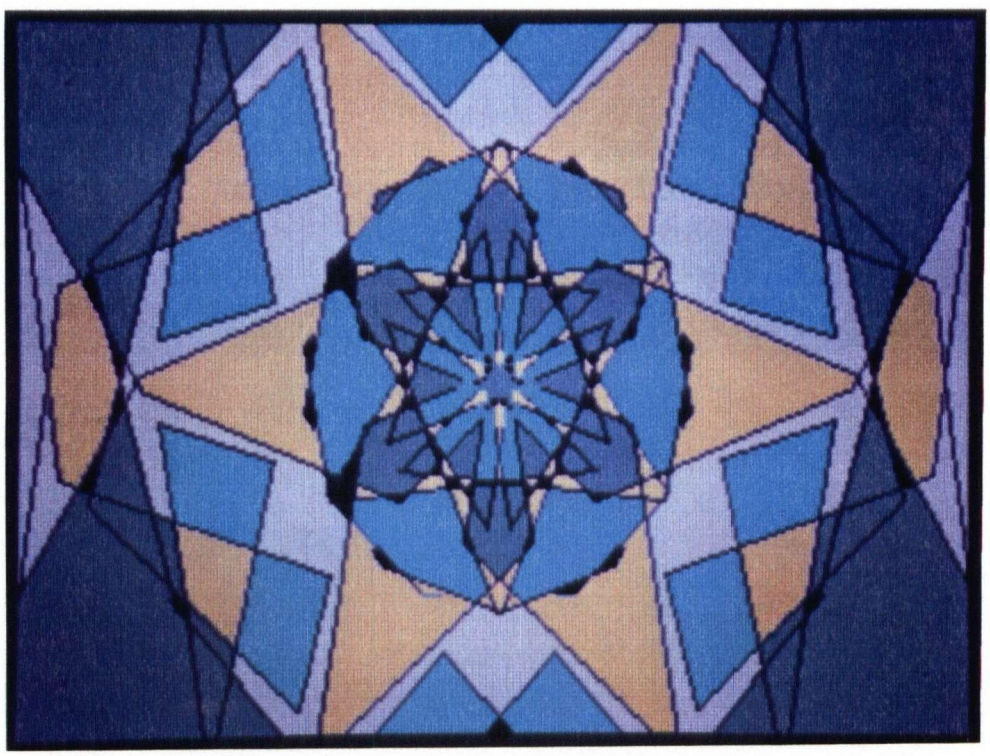


Figure 7. "Amanda" by Amanda Hackman.
Symmetry design that used custom palette.

The ability to make colour changes, not only global and drastic as in Amanda's image but also subtle and to individual colours, provided the students with opportunities for the continuous aesthetic decisions they made in respect to use of colour.

The creation and use of distinctly individual colours progressed to the use of ranges of just two or three colours. Each range could be *dithered* or intermingled to any chosen degree, and the students used such dithered ranges extensively. Figure 8 provides an example of the use of two colour ranges in varied degrees of

dither. The students enjoyed the effect of these two complementary colour ranges. The ranges were modified and used many times by at least four different students. Greg made the original modification of this palette of colours from a palette used in a demonstration image on the art program disk.

The discovery of the blue and gold palette came about when Greg arranged to stay after class time one afternoon so that he could experiment and create a gold colour. He mixed many gold colours over a period of half an hour but expressed dissatisfaction with all. I suggested that he load an image that I knew to be on the disk and check how another artist had created gold colours. He immediately expressed delight and checked the composition of each individual colour, but it was the combination of the graduated gold colours that provided the gold for which he had been searching. Greg recognized the need for the graduated range, liked the contrast provided by the blue range, and modified and used this palette for many of his images.

Figure 8. "Goldspace" by Greg Carson.
Two colour ranges used in varied degrees of dither.

Brent had observed the progress of the search for a gold colour and, two days later, decided to create silver. He succeeded through the creation of a range of seven graduated greys. Tonal gradations were used effectively in images created by many students who recognized the depth and perspective that were achieved in

their use. Figure 9 shows one of many images in which tonal gradations were used. Titles of such images often contained words that related to space. Tyler's image that he titled "Sun" is interesting because it contains elements that use tonal gradations in conjunction with a single colour schematic sun.

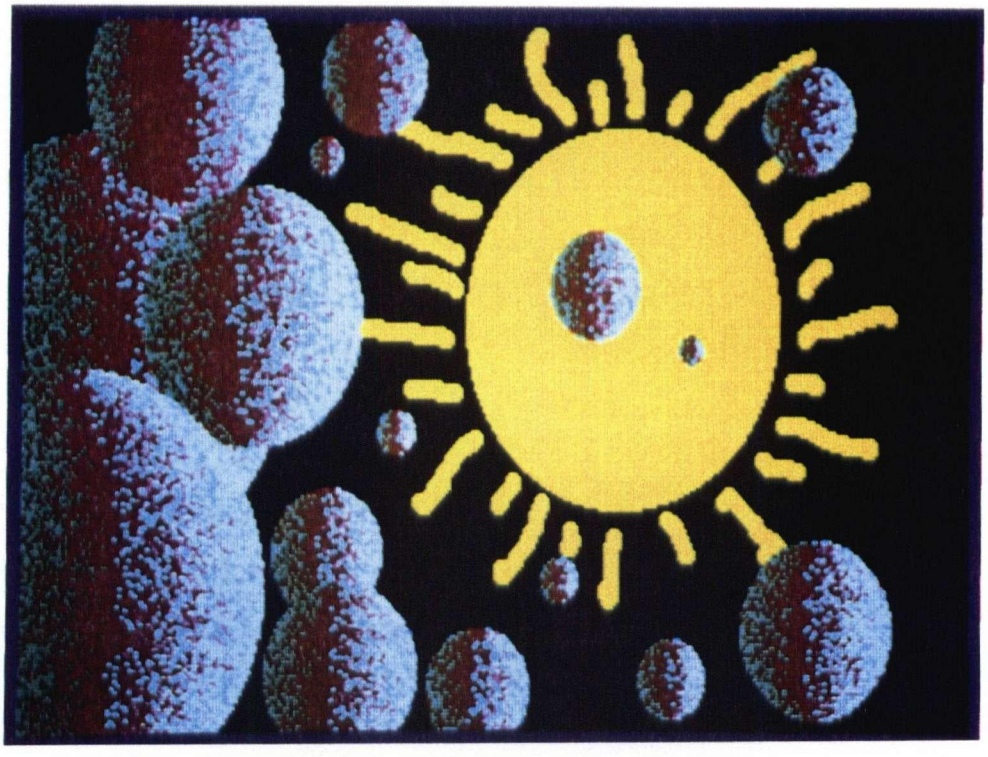


Figure 9. "Sun" by Tyler Orme.
Use of tonal gradations in image making.

Several students created monochromatic palettes. Images that used such palettes drew the loudest gasps of admiration from the audience of kindergarten to grade seven students when my students presented their computer art and music in the school gymnasium. The computer medium allowed grade four students to reveal a sensitive appreciation for monochromatic work. Such appreciation is not usually attributed to children of their ages. The audience response to the monochromatic works was indication that other elementary aged children also appreciated and derived pleasure from such images.

Extensive experimentation with single ideas was also made possible by other characteristics of the computer medium. The computer's speed and flexibility enabled prolific output within time frames suited to the concentration spans of grade four students. One outcome of the ease and speed of computer use was the wide range of techniques and applications with which each student experimented. A feature discovered or an idea

developed by one student would be seen by others and tried, modified, extended, used, or rejected very quickly.

An example of this type of experimentation began with the discovery of the effect of multiple circles that were drawn with a brush in colour cycle mode. Numbers of multicoloured concentric circles would be drawn. When the tab key was pressed, the colours in the circles cycled in their palette sequence, and a spinning animation effect was achieved. Nearly every student in the class produced an example of spinning circles. Many tried the technique, cleared the screen, and never tried it again. Many used the technique in compositions but each student gave a different meaning to the basic effect. Tyler said, "It looks like a big radar screen going around," and he used the technique from that viewpoint. Serena saw bicycle wheels, Elice visualized outer space, Sasha removed a segment and found a pizza, Brent expressed the movement and speed of baseballs without use of the colour cycle feature, and Elice sang as she used her "crazy records" to create an image. Nonrepresentational work produced by the students often expressed ideas and meanings and, for this reason, I considered many images to be abstract art and not decorative design. Figure 10 shows Brent's use of the multiple circle technique in the image that he titled "Baseball."

Figure 10. "Baseball" by Brent Smoes.

The ease and speed that were provided in use of the computer medium encouraged individual students to explore variations and create many images that were based on a single idea. The outcome was the development of image processing: the creation of series of images. Many students pursued the development of series of images and provided their series with titles. Stephen produced four images in his "King Tut's House" series. Greg had at least nine images in his "Goldspace" series. Tyler's "Space" series comprised images titled "Sun," "Moon," and "Planets." Christine's fifth and final image in her "Window" series is shown in Figure 11. Two earlier images in this series showed velvet textured drapes for which Christine had used the same technique as that used for the pom-poms in this image. The inclusion of both the sun and the rain cloud with lightning bolt is an example of the representation of two conflicting elements in one seemingly realistic image.

Figure 11. "Window Five" by Christine Smith.

David produced at least six images in his "Blue" series whose connecting link was the palette used. Two images from this series are shown in Figures 12 and 13. The titles of these images, "Dead Fish" and "Tornado," indicate abstract art and not design. Cary used monochromatic palettes of red, pink, blue, purple, green and grey for his "Hole" series, two of which are shown in Figures 14 and 15.

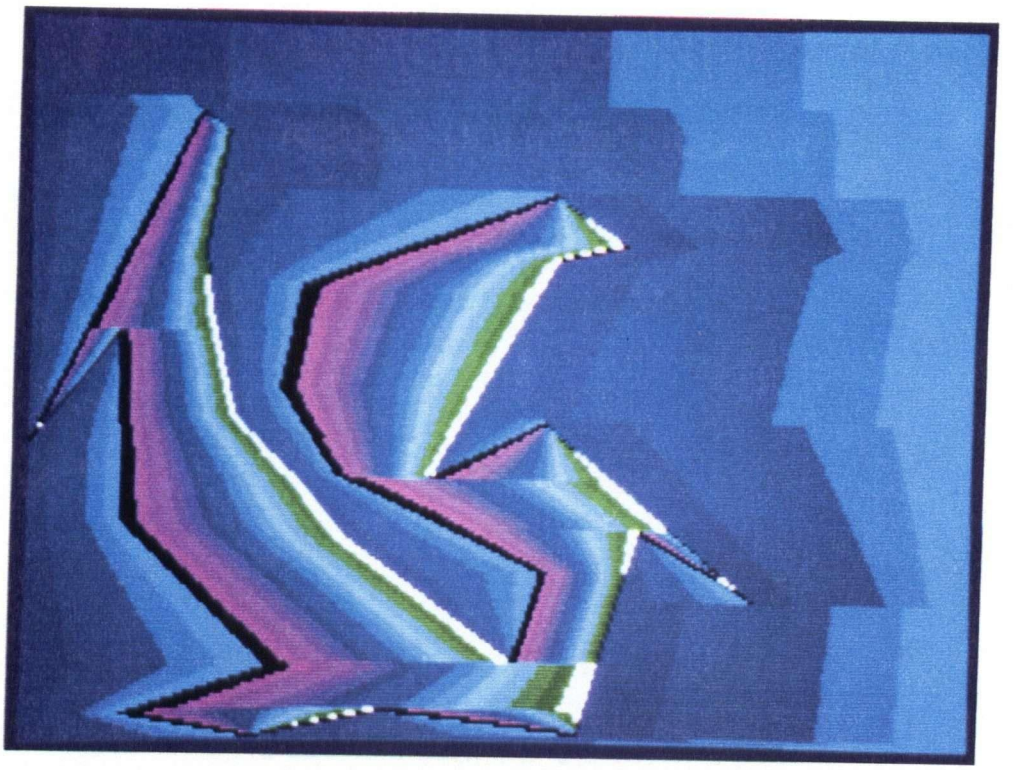


Figure 12. "Dead Fish" by David Ivanoff

Figure 13. "Tornado" by David Ivanoff

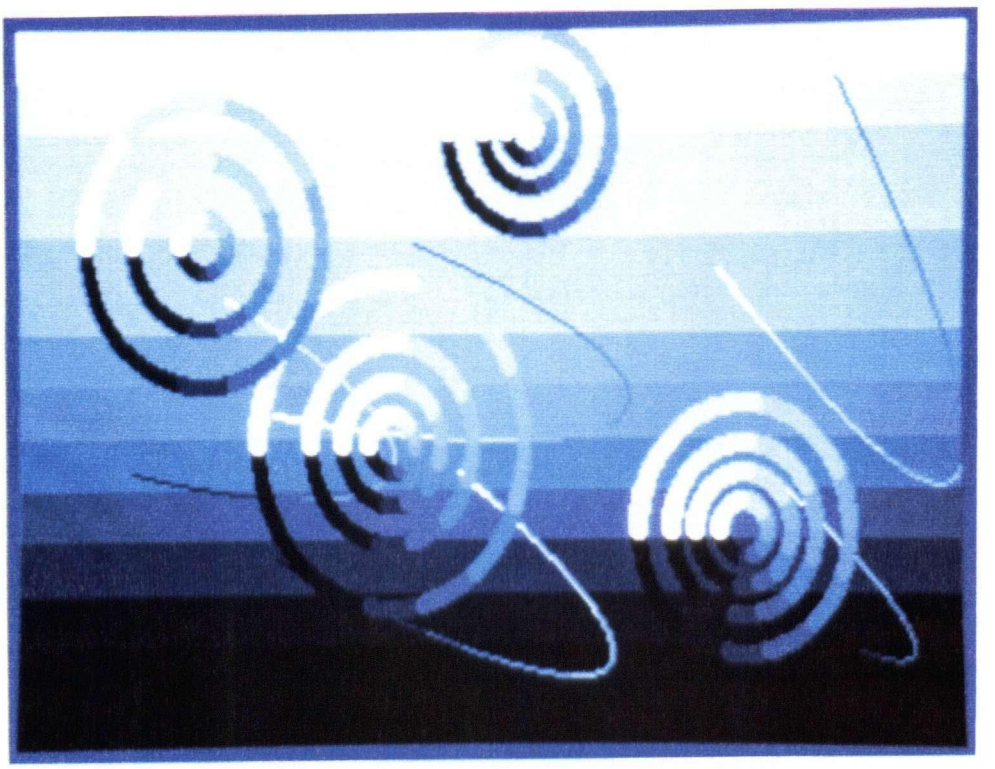


Figure 14. "Blue Hole" by Cary Polanski

Figure 15. "Red Hole" by Cary Polanski

Associative thinking as displayed in use of the word processing software was again displayed in use of the art software. Several students used the text tool to print their names and initials. Sections of the text were then transformed into brushes that were modified in many ways and used to create well balanced designs. Carrie created her image, shown in Figure 16, by the use of brushes that were single words of text. Just before Carrie saved this image, I asked her if she intended to leave the original single words in the finished image. Her affirmative answer was made in a manner that suggested she had made the decision previously while the work had been in progress.

Figure 16. "Word Picture" by Carrie Williamson

During my interviews with the students, they discussed their work in accurate terms that had been learned through use of the art program menus. Sheri described the shades of colours in her palette. Tyler talked of the blend of colours in a brush he had used. Others discussed symmetry and rotation of images. The students discussed their work as artists.

Adults who saw the students' images responded to the work of artists. Teachers who were in the staff room after the presentation of the computer art and music informally discussed what they had seen and heard in

terms that I had not often heard applied to students' art work. Particular works were described in relation to their colour, balance, form, and emotional impact. One comment even began, "It looked like . . .," and the teacher proceeded to describe her farewell on a cruise ship. She relived the excitement of a personal experience through her response to an abstract work of brightly coloured circles and dots.

A teacher who knew none of the student artists but saw the presentation of their work remarked that it was fortunate that the students had chosen to present some of the realistic images that were interspersed throughout the program. She explained that, otherwise, one could easily have forgotten that the images were the work of grade four students.

The use of the computer as a medium allowed the students to progress to a developmental stage in which their work was nonrepresentational. The images that the students created lacked the characteristics that enabled them to be recognized as typical work produced by children of grade four age. The images displayed a sophistication not usually expected or seen in the work of such young artists.

Music

Music composition by students of grade four age is usually severely restricted because students are daunted by the complexities of traditional notation and performance of the music. I had in previous years involved grade four students, individually, in groups, and in full classes, in the development of improvised sound compositions. These compositions were often tape recorded and notated in nontraditional symbols. Another form of composition in which students composed and notated simple melodic lines that could be played on xylophones or recorders seldom resulted in expressions of satisfaction by the student composers.

The computer music software program alleviated the notational and performance problems of music composition and provided a means for students to explore music composition in a manner not previously available. Before the music software was introduced, the students in this study had attained varied degrees of proficiency in rhythm reading, sight singing of pentatonic songs, and use of absolute pitch names on the treble staff for recorder playing.

Only one student initially hesitated as she approached her first experience with the music software program. She stood in front of the computer and remarked, "I don't think I can do it." I suggested she try, and within five minutes she was smiling and completely involved in exploring the program's capabilities.

At the beginning of the third school term, I noted in my journal that the students in use of the computer music program appeared to be putting sounds together for the sheer joy of hearing the combinations that were produced. Richard loaded one of his compositions and said, "This is the best one I ever wrote." I asked him what he liked about it, and he pointed to the monitor screen and explained, "I like the beginning. See, it goes like this at the top and bottom with this bit in the middle." He then added, "I like the combination of instruments I used," and insisted that I listen twice to the whole composition.

Students quickly discovered the four different preprogrammed sound palettes: jazz, rock, classical, and voices. Colour coded notes appeared on the screen to indicate each of the 15 sounds available in each palette. The sound produced by each note was played as the note was positioned on the grand staff that was displayed on the screen. At any time, a whole composition or chosen sections could be played. The students wore headphones while they worked with the music program and were able to hear each note they positioned and replay their work as often as they wished without causing disturbance to others in the classroom.

The music performance capability of the computer was used extensively. A seven minute period of activity by Sasha demonstrated typical use of the performance capability as well as other practices typical of all students in their use of the music software.

Sasha loaded an unfinished composition with the comment, "This is the one I like," and played the entire eight second composition. He then slowed the tempo to andante and replayed the work. With the same tempo setting, he replayed to about half way, stopped the replay, and moved the end of the composition on to the screen. He chose the mute bass instrument sound but then changed it to a piano sound and added a descending and ascending scale run that encompassed the full octave range of bass and treble staves.

Sasha played the whole composition again and then replayed to a section near the end where he had used a single instrument in mid staff range. He selected a drum sound and added notes both higher and lower than those already used in the section and then played only the section that had been altered. He scrolled to the beginning of the composition and handed the headphones to me.

Sasha had made several decisions about his composition. The decisions had been made because he had been able to hear his composition performed. He had altered the tempo and indicated satisfaction by his retention of the change. A phrase had been added to extend the composition. A thinly textured section had been given increased solidity.

I observed many other students repeatedly listen to their compositions for the same reasons as had Sasha. Students listened before they extended a composition. They changed tempi and instrument timbres and listened for the effects of the changes. They found sections of their compositions unsatisfactory and deleted, added to, or changed the sections. They also listened for pleasure.

Students showed that they enjoyed listening to their own compositions by their smiles as they did so and the number of times they replayed their music. A boy greeted me one morning before class with the comment, "Just playing through all my songs." Another boy tape recorded all his compositions. Two weeks later, his mother told me that he played the tape every night when he went to bed.

Comments and actions of the students as they listened to their own compositions also demonstrated their pleasure. Many hummed or vocalized syllables as their music played, and some moved rhythmically to their compositions. Frequent comments such as "Sounds good!" indicated approval for their own work. A boy and girl were heard to repeat "Boring!" several times, yawn loudly, and laugh as they listened to a slow section of the boy's composition. Despite the comment, they both continued to listen, and the boy made no attempt to alter the slow section that was between two sections in quick tempo.

Many students demonstrated that they related the notation that scrolled across the screen to its performance. David wore headphones and was about to play one of his long compositions when I stood beside him. He started the performance, forgot that I couldn't hear, and explained, "It's mostly drums at the beginning." He listened and watched attentively for a while and then said, "Here it comes." Immediately after he had made the comment, a distinctive group of five notes scrolled on to the screen. He raised his arms and conducted the group of notes as it played.

Greg also demonstrated that he related the notation to the sound. He smiled broadly as I stopped to look at his work and said, "I like this." He pointed to a section of his composition and elaborated, "I like the way it goes . . . ." He then sang the pattern of the scale and trill that were displayed on the screen.

Trevor displayed a different understanding of the sound and notation relationship of a composition which he had ended with a chord that comprised at least 12 notes in random placement. He jigged his body in time to the music as it played and, as the final chord sounded, said "Boomp." He turned to me and explained, "It sounds like a door shutting."

Comments that began "It sounds like . . ." were infrequent, and their scarcity contrasted with the

frequency of equivalent comments that began "It looks like . . ." when students worked with the art program. It appeared that the music compositions were accepted as absolute music. No attempts were made to compose sound sequences that expressed stories or imitated or represented other sounds. Sasha titled one of his compositions "Cars" but explained that he had composed the piece before the thought came to him that his music sounded like cars. Most compositions were saved with titles that used a student's name and a sequence number. Many others were named for an instrument or a sound palette that was used in their composition.

Students wanted others to listen to their compositions. Sasha's act of handing the headphones to me was an act typical of students who worked with the music program. I often heard the call, "Come and listen to this." Peers were constantly invited to listen to whole compositions or particular sections. I never heard or saw a student refuse to listen to the work of another.

I saw one girl place the headphones on the girl who was word processing beside her and proceed to load and play every composition that she had written. The second girl made no objection, continued her word processing, and showed by occasional comments that she listened attentively. Remarks included, "You used the voices," "That bit's neat," and "That didn't sound finished."

Many times a student would remove the headphones and beckon a peer to the computer to listen. Often the student who listened would beckon another. Sometimes the general curiosity that grew would result in removal of the headphone connection from the computer so that we all could listen to a performance. During the third school term, the students requested that one student each day be given time to play a chosen composition for the whole class as a component of the daily opening exercises.

Three students transcribed simple recorder melodies during their initial sessions with the music software program. None of the three was satisfied with the computer's performance of the melodies. The boy didn't bother to save his notation. The two girls added treble and bass parts as well as extended endings to their melodies until they were satisfied by the sound of the performances. I considered that the music software provided staccato performance of standard notation and that the preprogrammed sounds were electronic in timbre. The fact that the students decided not to pursue transcription of melodies suggested that they recognized that the characteristics of the available sounds could be used more effectively for nonmelodic composition. During my interview with her, a girl told me that she had been to a concert where she had heard "the original instruments." She commented that they "sounded so weird" because she was "used to the computer."

Approaches to music composition revealed the same three steps that I had observed in approaches to computer art. Students first experimented in a random manner. One boy described this step as "just fooling around." Next came experimentation and repeated patterning of some discovery. The girl who pointed to a scale pattern and said, "Look, I'm going to make this with every instrument," demonstrated the second step. Finally, the discoveries were used consciously in the composition of music.

The students' compositions used every element of music, some to greater extent than others, and the traditional symbols of music notation. However, many symbols were not used according to traditional notation conventions. Different time signatures and key signatures were selected to "see what happened," as one boy explained his selection of a key signature with six flats. Nothing happened that the students noticed because no consideration was ever given to a tonal centre for a chosen key or to the use of bar lines, but students continued to make random selection of these features.

Students devised different ways to make their compositions sound finished. One girl used a short trill motif followed by a nontraditional chord. Others used a series of such chords to end a composition. One boy selected a bar line, positioned it at the end of his composition, and said, "There! That will show it's finished."

All students employed the various elements of music in similar manners. Pitch placements covered five octaves, but melody lines were not developed. Repeated note durations provided compositions with a steady beat, but rhythms of varied note durations were not created. Harmony of a dissonant nature was commonly used and was often thickly textured. Tempo changes were made frequently through use of the scroll bar that set tempi from grave to prestissimo. Within a composition, tempo changes were usually extreme. For example, a passage of thirty-second notes would be followed by a passage of whole notes. The most often used note duration for initial compositions was the thirty-second note which was often used in conjunction with a performance tempo set at grave. Fortissimo was the favoured dynamics level. This choice was understandable because the volume of sound output by the computer even at this setting was not great.

Timbre appeared important to the students. They used all 60 preprogrammed sounds. The sounds provided on the voice palette were not as popular as those on the jazz, rock, and classical palettes. The sound palettes sometimes were changed and each used in turn to play one composition. However, the original sound palette of a composition usually was retained. Discussions about the suitability of different sounds for certain parts of compositions took place. Overheard comments included, "You won't hear the tenor sax down there,"

"I need the vibes here," and "Use the simmons for that bit. It's totally . . . ." The boy who made the last comment was unable to find a word to describe the sound, but he knew that it was the right sound for the part.

A seemingly innate sense of form was displayed by students in the use of phrasing in their compositions. This strong sense of phrase form was related to the manner in which students developed their music composition skills. Various building blocks, or compositional components, were developed and then repeated, alternated, or interspersed to create compositions with definite phrase forms. The development of the building blocks demonstrated the previously discussed steps of random use of something newly discovered followed by experimental and patterned use. The third step, conscious use, was demonstrated as the building blocks were combined to create music compositions.

The order in which the different building blocks were developed was generally the same for all students. The number and complexity of blocks used in compositions by different students varied. The later stages of development that are described were not observed in all students, but the examples that have been selected to illustrate the progressive stages are typical for the students who were involved in this study. A cassette tape contains recorded selections that include each notated example of music shown in Figures 17 to 39.

Initial random exploration resulted in blocks of scattered notation similar to that shown in Figure 17. All note durations that were used in a random block were the same. Usually, the thirty-second note was selected. Several different instrument sounds were scattered at pitches throughout the five octave range that was available for use. Short random blocks were later used as components of compositions by some students. Carmen indicated her opinion of the performance sound of the random block that is shown in Figure 17 when she titled it "Mumbo Jumbo."

Most students reacted to the performance sound of such blocks in manners similar to the girl who listened and then remarked, "This is terrible." Three peers who in turn listened through the headphones agreed with her, but each repeated the listening experience several times. Another girl replayed her random block the day after she had written and saved it and commented, "Just sticking it anywhere doesn't work."

After initial random exploration, a more selective, but still random, approach to music composition was taken. Students selected and concentrated on the use of a single instrument timbre or restricted the pitch range of the instruments that they chose to use. Notes of the same duration were again used for these selective random blocks. Many students used each of the 15 instruments that was available in the chosen palette to notate

consecutive random blocks similar to the one shown in Figure 18. Different instrument sounds were sometimes allotted their own pitch ranges which provided the layered effect shown in Figure 19.

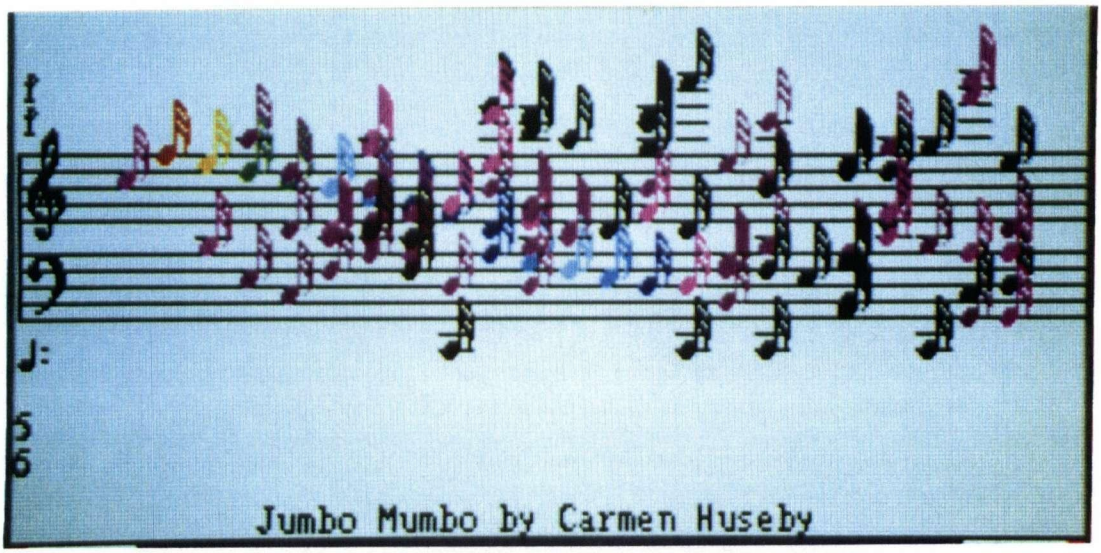


Figure 17. Random compositional block.
Different instrument timbres are used for random placement of notes on staff.

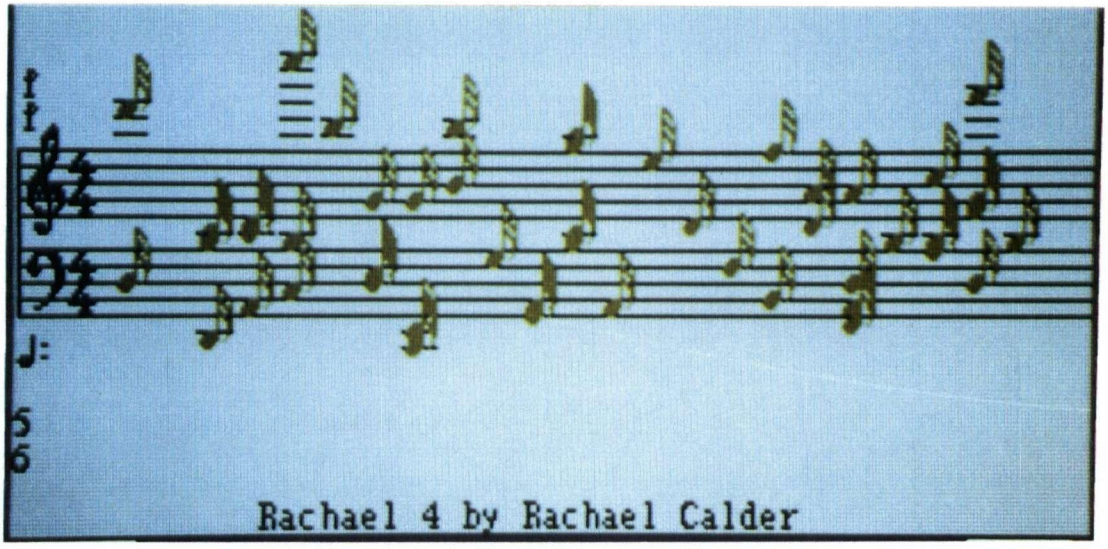


Figure 18. Selective random block.
A single instrument is used for random placement of notes on staff.

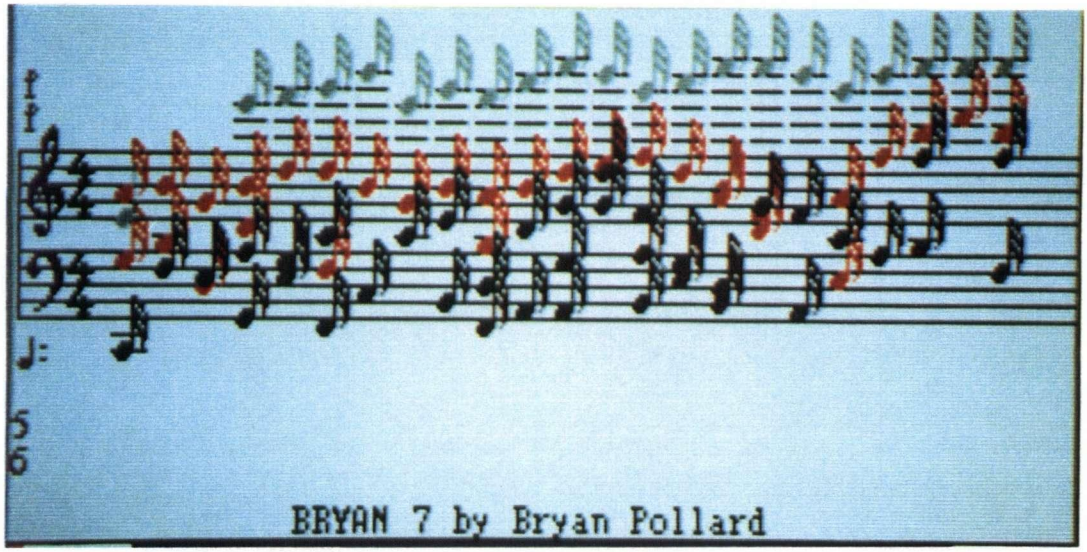


Figure 19. Selective random block.
Different instrument timbres are used in separate pitch ranges.

Stacked chords developed during selective random exploration. The stacked chords were usually comprised of notes played by a single instrument but sometimes used a combination of sounds in each chord. Figure 20 shows one stacked chord between scale runs.

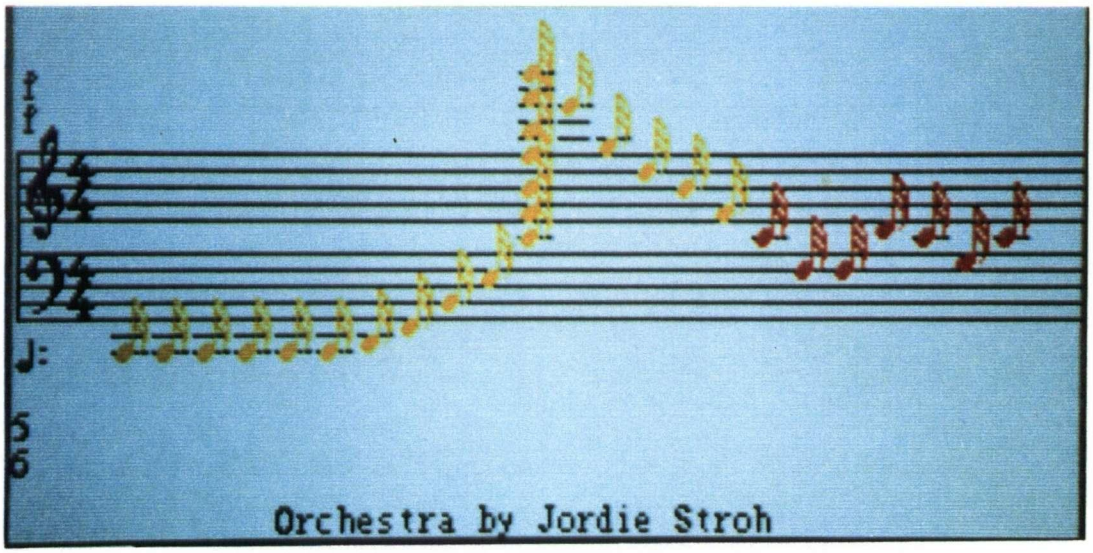


Figure 20. Stacked chord used in a composition.

Stacked chords were often used singly to indicate phrase ends or ends of compositions but also were used in groups as compositional blocks.

Scale patterned building blocks were the next development. Students first used a single instrument and a single note duration to notate a five octave ascending and descending scale. The pattern was often repeated with every instrument sound. The instrument timbre was sometimes changed at each highest and lowest pitch to provide variation to the basic scale pattern. The scale progressions were notated in steps, thirds, or larger irregular intervals which produced arpeggio effects. A section of a basic scale pattern is shown in Figure 21.

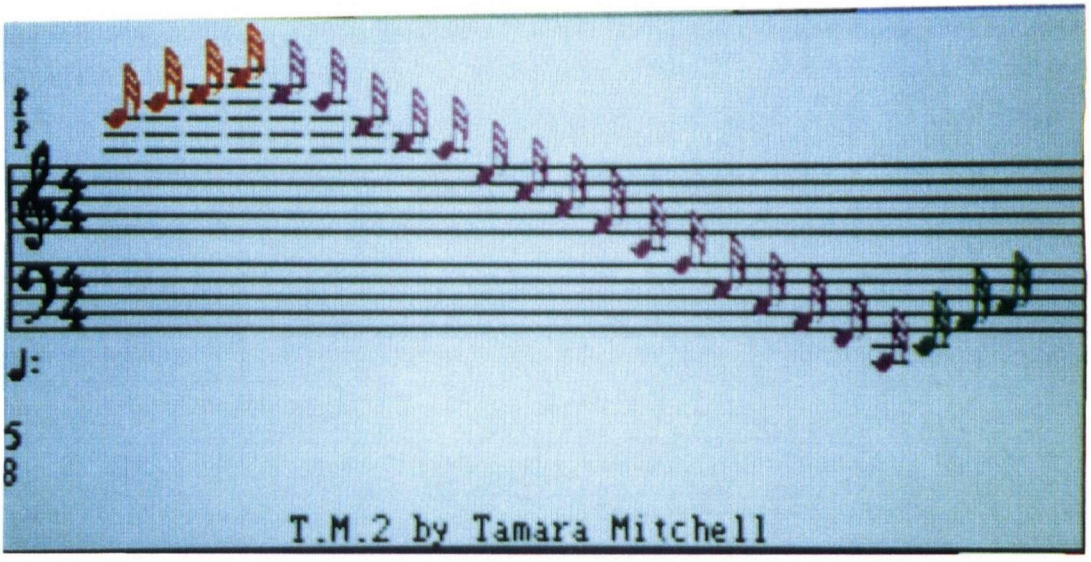


Figure 21. Basic scale pattern.
Instrument timbres were changed at highest and lowest pitches.

Experimentation with these basic scale patterns permitted the students to become familiar with the sound of every instrument at every pitch on the staff.

Variations of the basic scale patterns were developed. One common variation was the notation of parallel scales that each used different instrument timbres. Each scale appeared as a single line. An example of this type of scale variation can be seen in Figure 22.

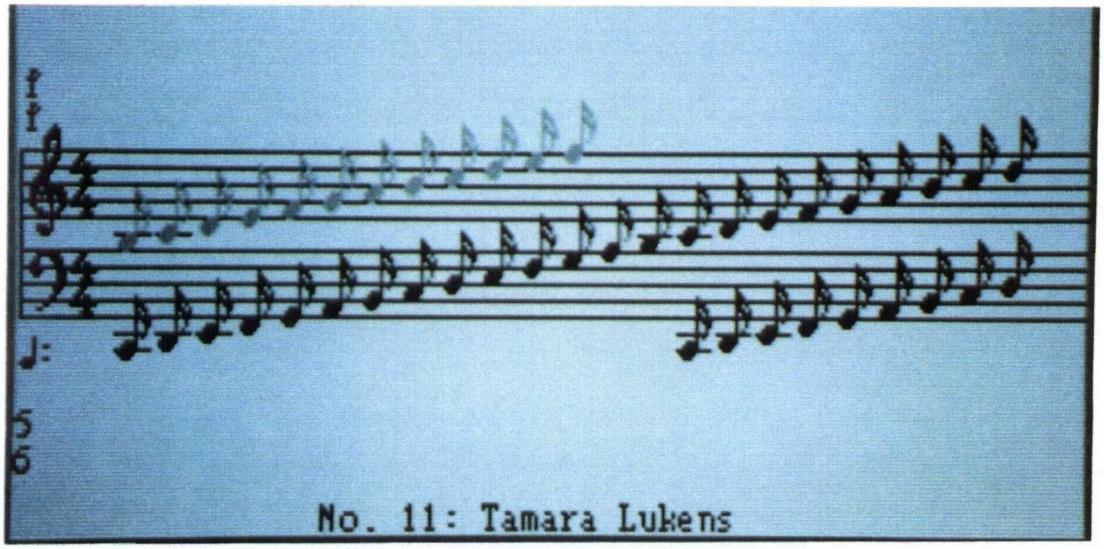


Figure 22. Scale pattern variation.
Different instrument timbres were used in parallel scales.

When these parallel scales were placed closer together, a harmonized effect was achieved. Harmonies were often notated in third intervals or in approximations of triads as shown in Figure 23.

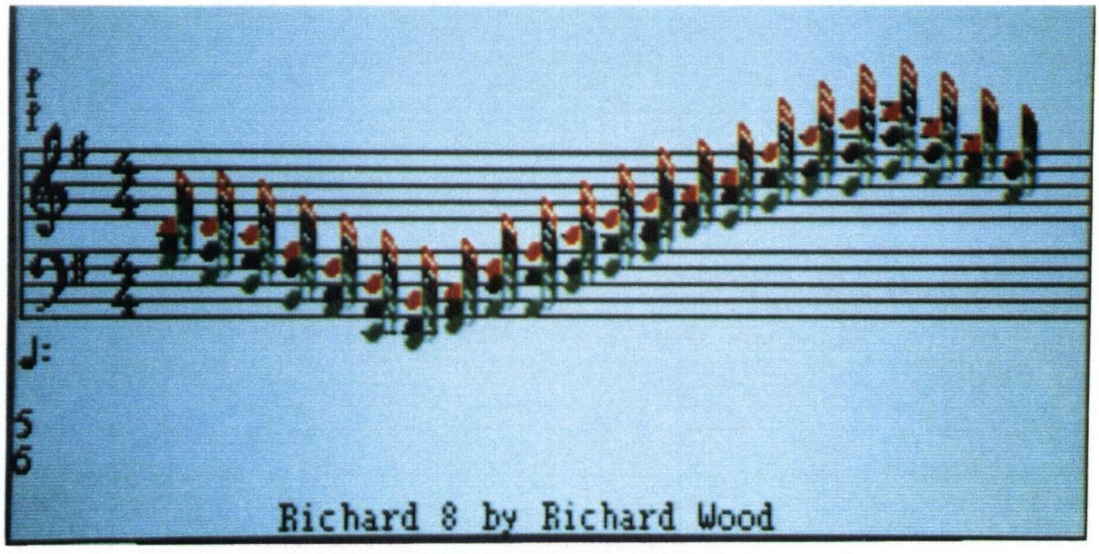


Figure 23. Scale pattern variation. Harmonized scale pattern.

Crossed scales were another variation of the basic scale patterns. The crossed scales were often sectioned or phrased by changes made to the instruments that were used. Christine used two different instruments in the crossed scale pattern that is shown in Figure 24.

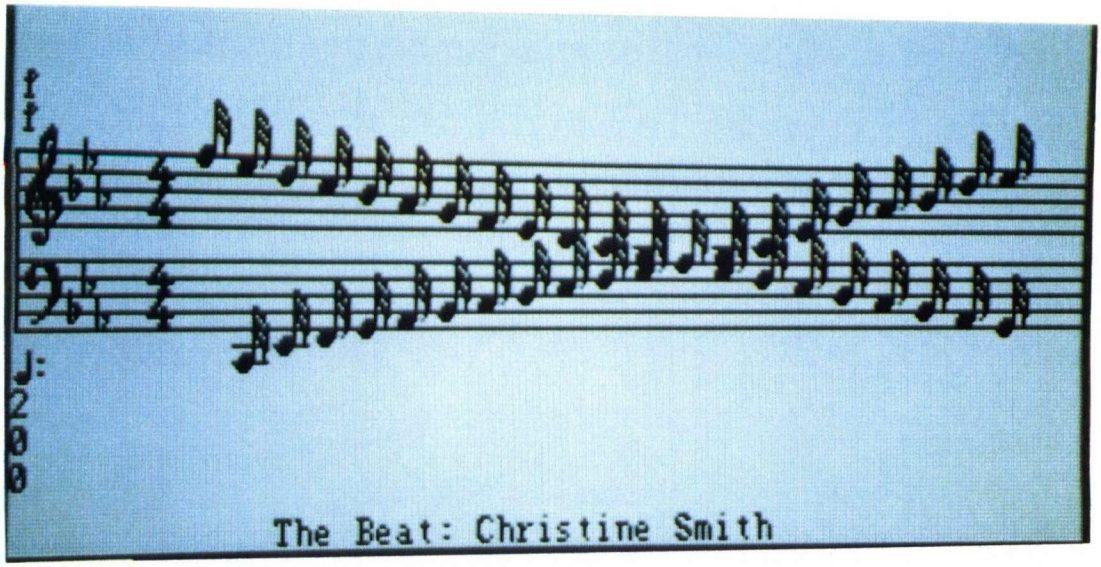


Figure 24. Scale pattern variation.
Crossed scales.

Students discovered that scale patterns played prestissimo produced interesting animation effects as they scrolled across the monitor screen. Visual enjoyment of the scales apparently did not provide enjoyable listening. Most students removed the headphones before they watched the scales weave across the screen.

Monotone ostinati were next developed and used extensively. The development of the monotone ostinati appeared to result from the desire of most students to give a thicker and richer texture to the sound of their compositions. The ostinati also established the feeling of a steady, often insistent, beat.

Elice used monotone ostinati at pitches above and below a transcription of a simple melody. The melody was one that the students played on their recorders, but Elice did not like the way that the computer performed the melody. Her arrangement of "Hot Cross Buns" for performance by computer is shown in Figure 25.

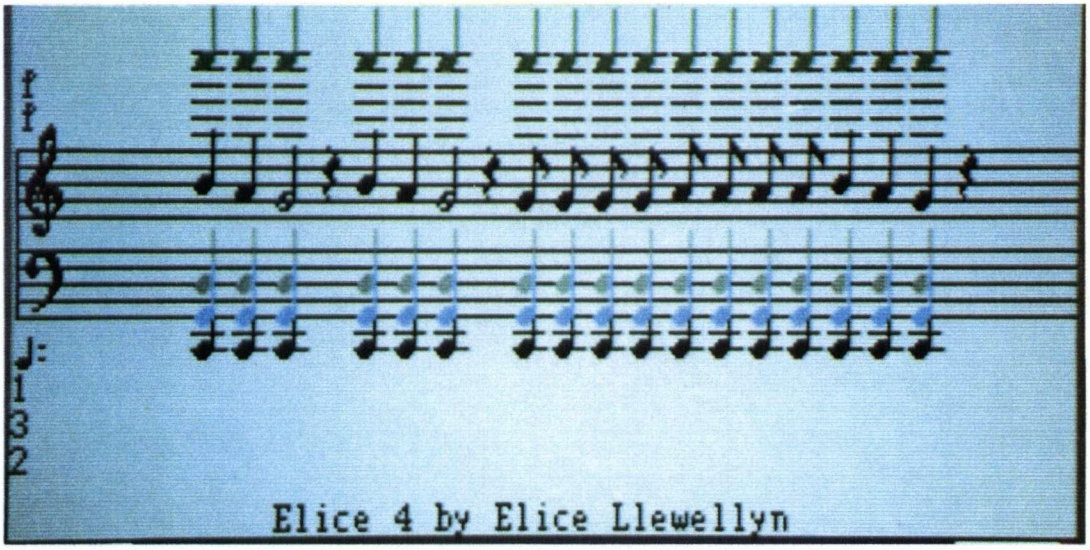


Figure 25. Monotone ostinati.
Ostinati used with a transcribed melody.

A variation of a monotone ostinato was the trill like pattern that alternated notes in intervals up to fifths. Trill ostinati were also frequently used in compositions.

The random, selective random, scale, and ostinato patterns were basic components of the compositional building blocks that all the students used in their music compositions. Progression from the experimental stage with various building blocks to their conscious use in compositions developed almost imperceptibly. Students put groups of sounds together to produce compositions that they considered satisfactory. In doing so, they appeared to work naturally with the element of form.

The various patterns were refined, modified, and combined to create phrase length blocks. The phrases were then alternated, repeated, or interspersed to create music compositions. A combination of scale and ostinato patterns provided phrased blocks of step progressions. One student used the width of the screen to determine the length of each phrase in a step progression series. He entered notes of the same pitch until the screen was filled and then scrolled the display until only the last note that he had entered was visible. He then repeated the procedure for each step of a two octave ascending scale range.

The basic patterns were used in many different ways by different students. Figure 26 shows a section of

an arpeggio pattern used with a monotone ostinato. Figure 27 shows a descending scale pattern that uses alternating instrument timbres combined with monotone ostinati.

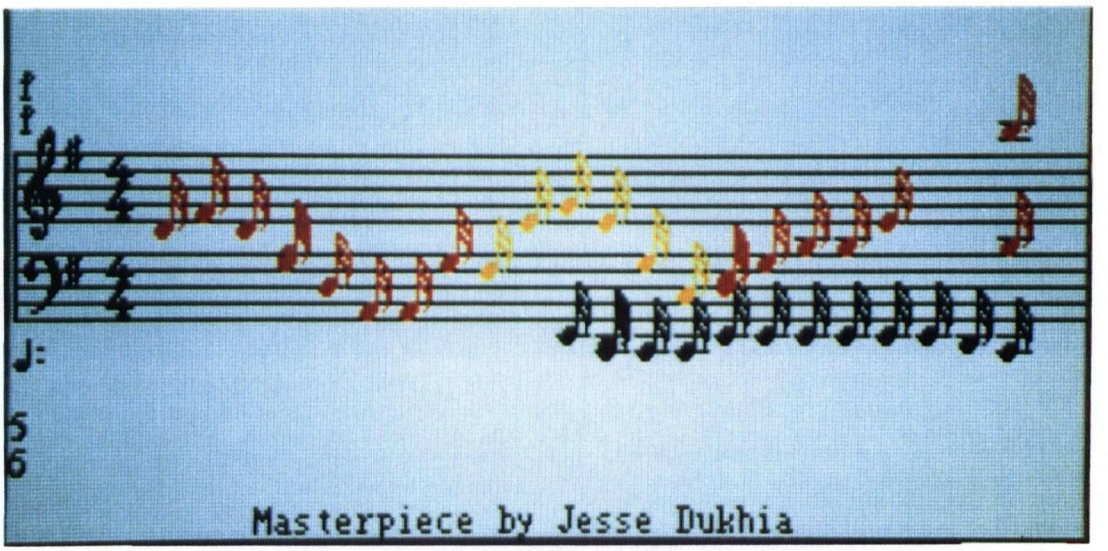


Figure 26. Combination of arpeggio pattern and monotone ostinato.

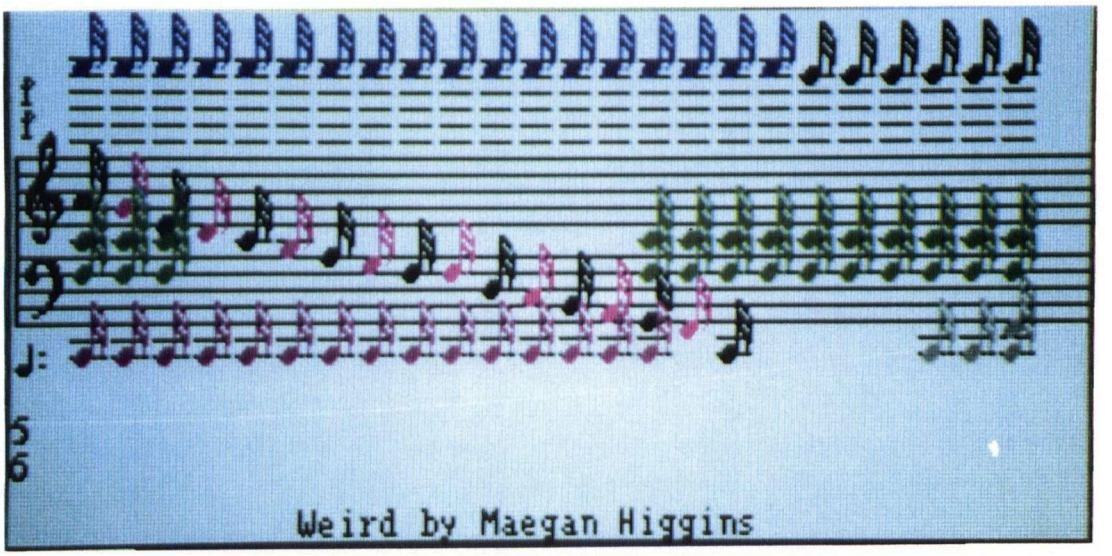


Figure 27. Combination of descending scale segments and monotone ostinati.

Figure 28 shows the use of alternating instrument timbres in the creation of phrases. The descending scale segments were repeated in phrase lengths that alternated piano and flute.

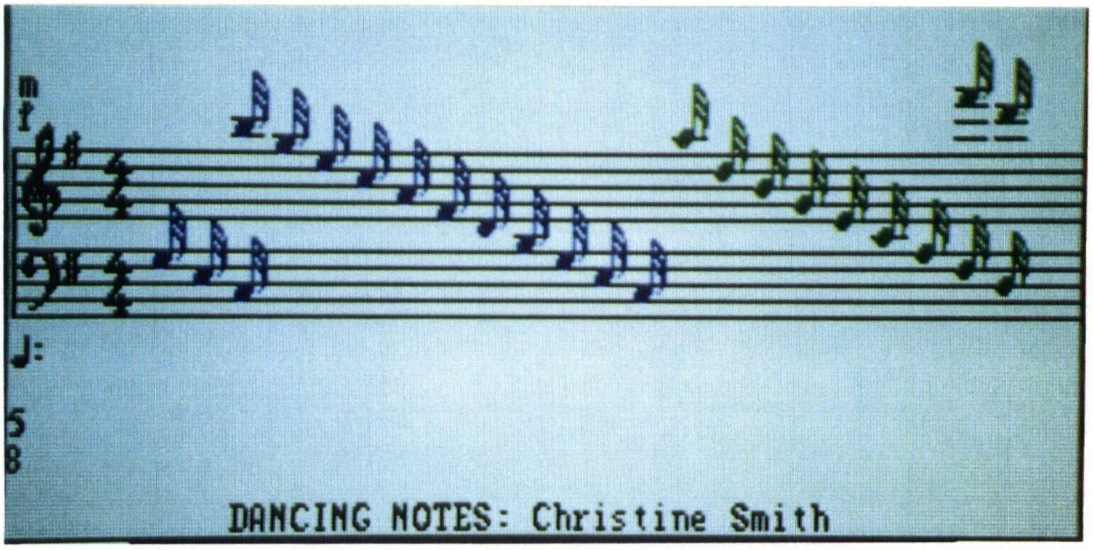


Figure 28. Descending scale segments that use different instrument timbres to create phrases.

Students rarely verbalized what they were doing or why they were doing it when they notated compositions. They listened and they notated. Sometimes they notated several blocks before they again listened. I observed a boy notate at least six blocks of an ostinato and scale series pattern before he replayed his work from the beginning. When he did so, I saw that selective random blocks separated by stacked chords preceded the pattern that I had seen him notate. He scrolled the music back to the beginning, pointed to a random block, and said, "I'm going to put two of these at the end."

Most students gave consideration to the ends of their compositions and expressed appreciation when they heard a work that achieved a sense of completion. One boy's only comment after he listened to a particular composition was, "You sure know how to make it sound ended."

Endings of compositions often used a pattern or phrase block that had not been used elsewhere in the composition which suggested that the ending was of particular importance. Figure 29 shows the beginning of a composition that used scale series as building blocks. The high pitched monotone ostinato was used

throughout. The first ascending scale series used pairs of notes until it reached the pitch level of the ostinato and then descended. The pattern was repeated, but each step used notes in groups of 20 instead of in pairs. The composition was then ended with an arpeggio pattern. Lori also used an arpeggio pattern to end one of her compositions but followed it with a stacked chord. The ending of Lori's composition is shown in Figure 30.

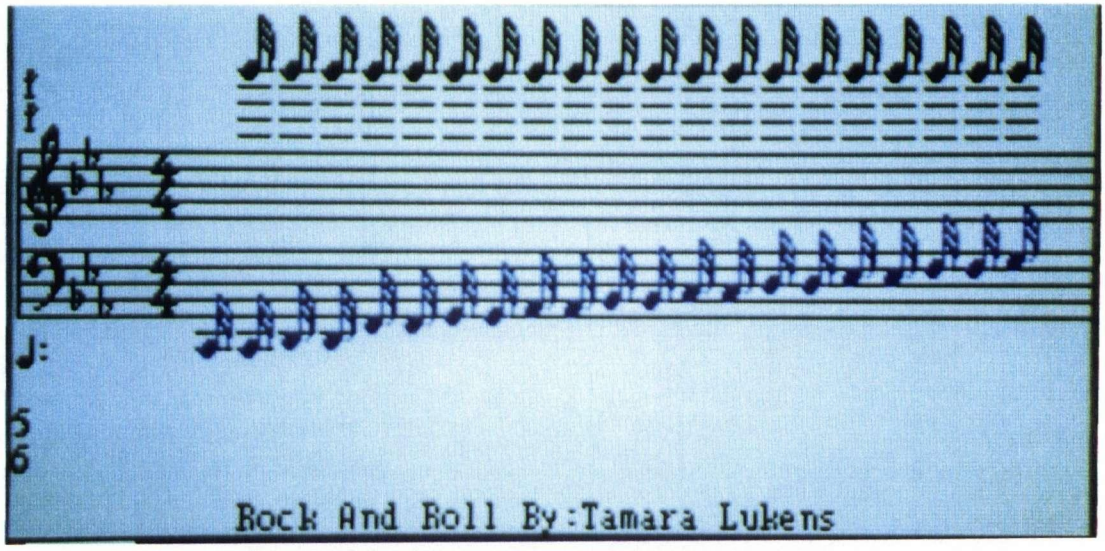


Figure 29. Scale series developed through combination of scale pattern and monotone ostinato.

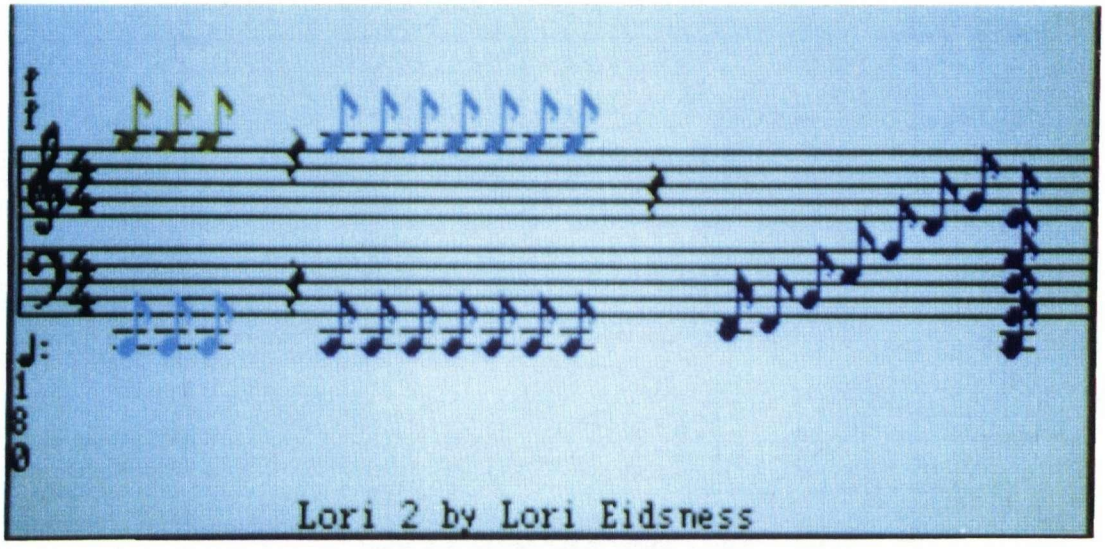


Figure 30. Composition ending. An arpeggio pattern followed by a stacked chord.

Elice began one of her compositions with a monotone ostinato pattern that alternated instruments as shown in Figure 31. However, she ended the composition with the only crossed scale phrase block that was used in that particular work. The crossed scale phrase and stacked chord ending are shown in Figure 32.

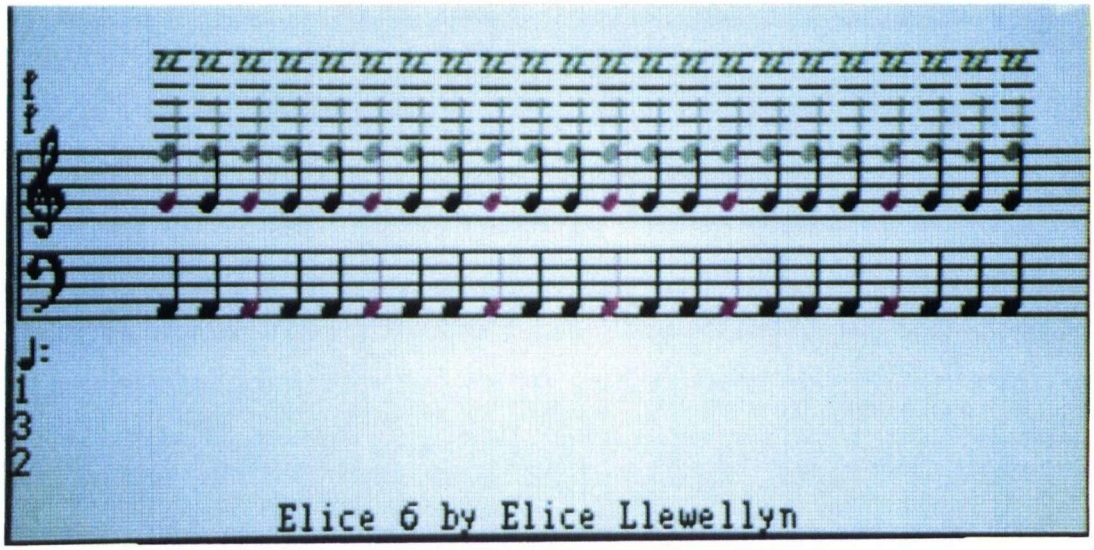


Figure 31. Composition beginning. Instrument timbres are alternated in a monotone ostinato.

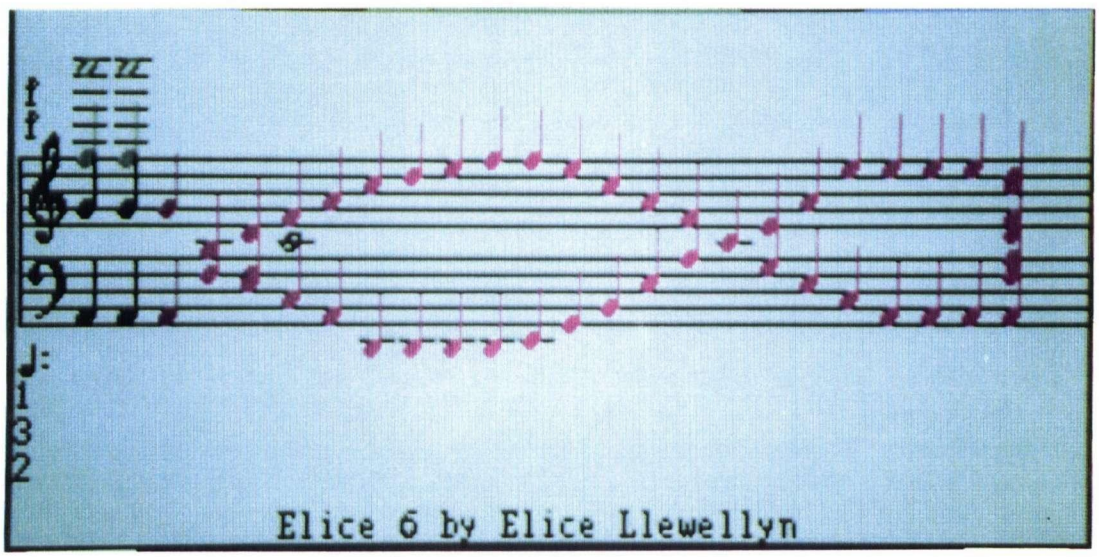


Figure 32. Composition ending. A crossed scale pattern is followed by a stacked chord.

JoAnna began one of her compositions with a block of stacked chords which were followed by parallel scales. The beginning of this composition is shown in Figure 33. The half note ending, shown in Figure 34, followed several random blocks that each used a different instrument timbre.

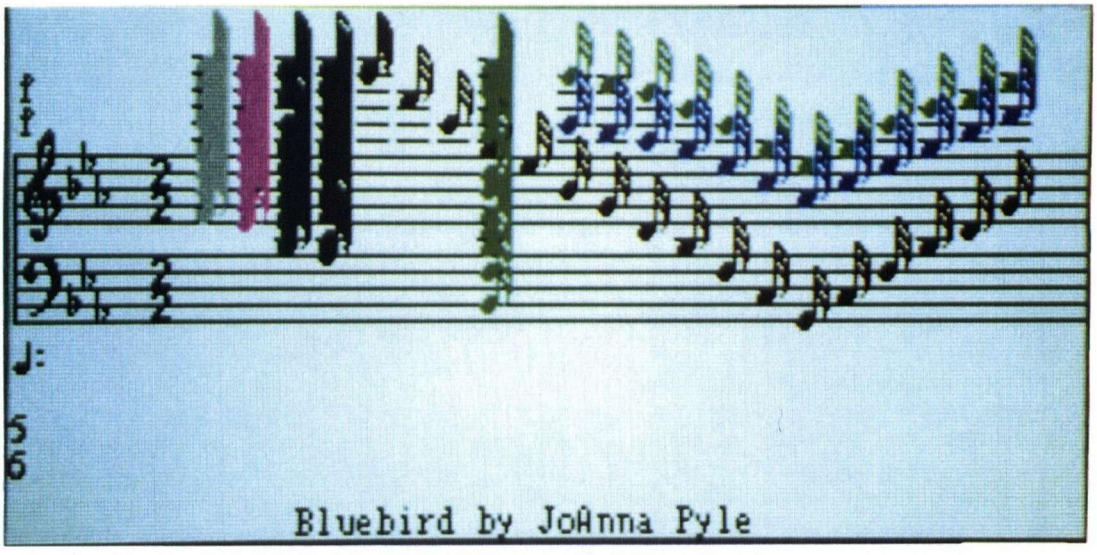


Figure 33. Composition beginning. Stacked chords followed by parallel scales.

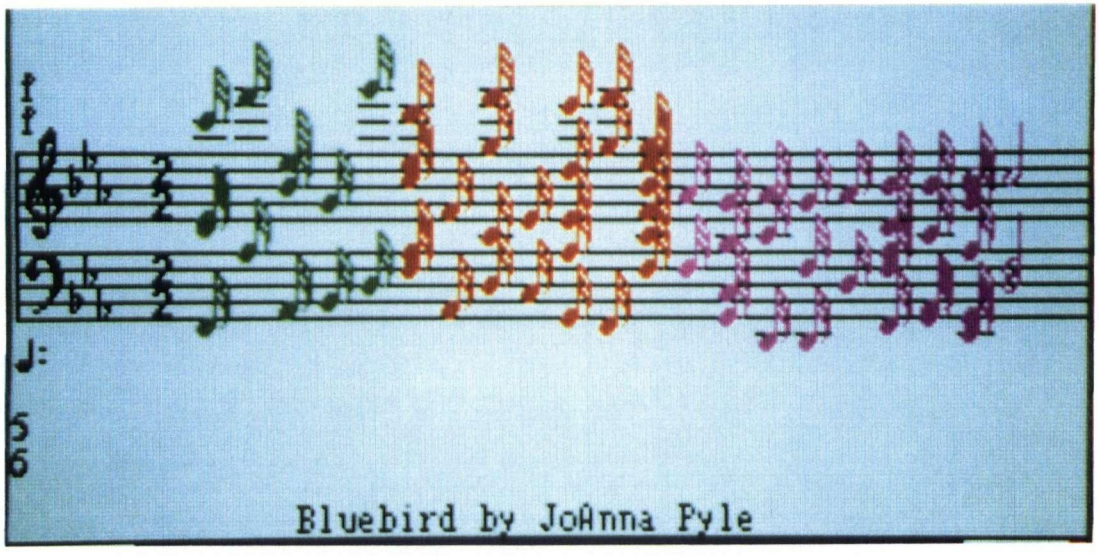


Figure 34. Composition ending. Half notes follow random blocks.

The use of half notes at the end of JoAnna's composition provides an example of the purposeful use of notes of mixed duration. Initially, any note duration that a student selected was used exclusively for the notation of any one compositional block.

Near the end of the school year, several students began to experiment with mixed note durations, dotted notes, accents, and repeat signs. The first indication that students might develop melody lines was also observed near the end of the school year. Elice notated a melodic motif and used different instruments to repeat the motif in the section of her composition that is shown in Figure 35.

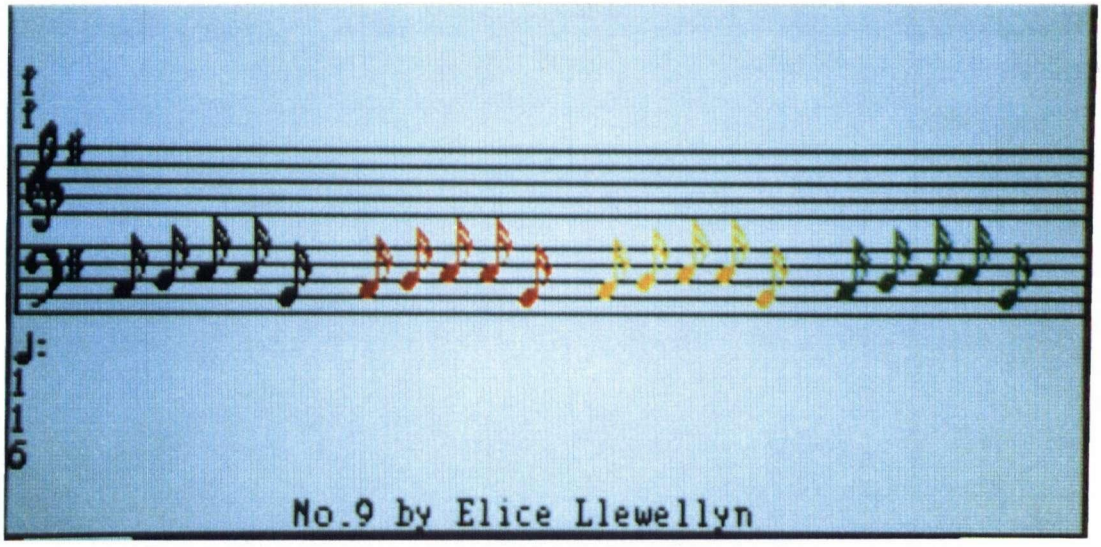


Figure 35. Melodic motif. Different instrument timbres are used for repeats of the motif.

Many features of the music software program were not used by the students. Only one student learned to copy a section of music to another place in a composition. No one appeared interested in transposition or doubled and halved note values, but four students showed interest in designing their own sounds and experimented with the sound envelopes of some of the preprogrammed instruments.

One girl made many alterations to the sound envelope of a bassoon and listened intently to the new sound created by each alteration. She appeared fascinated by the procedure and the results and, at one stage, her body shivered as she remarked, "I can change it to sound different."

The creation of visual compositions was not a progressive stage in music composition development but rather an example of the effects of associative thinking skills applied to the music software program. At least two students used the colour coded notes because of their colours, not their sounds. Brent diagonally positioned whole notes to form a rainbow that covered the grand staff. Maegan achieved a rainbow effect by the use of thirty-second notes. The resulting composition that she titled "Jazzy" is shown in Figure 36.

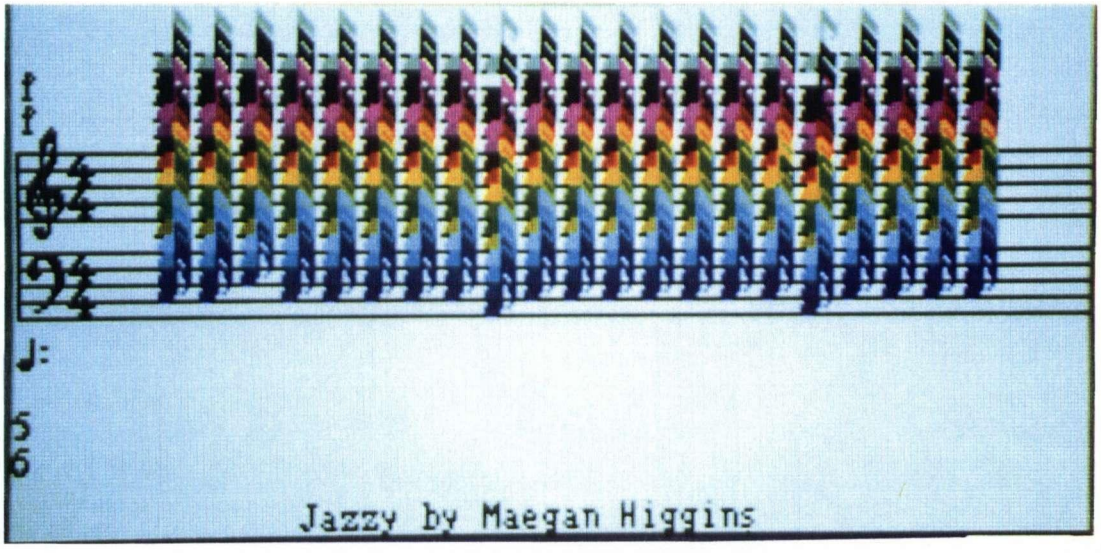


Figure 36. Visual composition. Notes were selected because of colour, not sound.

Visual compositions were also created by use of the music program's *paintbox* feature. The paintbox had been discovered by the students shortly after they began to use the program but had elicited little interest. A girl had looked at the rectangles of varied size and colour that represented the notes, shrugged, and clicked back to the main composing screen. A boy had commented, "This isn't as much fun. You can't really see what's happening." The students preferred to work with the traditional music notation. However, during the final month of the study, five students rediscovered and used the paintbox.

The students used their own names for the first experiments with the paintbox. Carmen used the coloured rectangles to form her name on the treble staff. Carrie printed her name in coloured rectangles on both treble and bass staves. Neither girl liked the music performance of her name used as notation. Tamara used the large

rectangles that represented whole notes to draw a series of faces, but the performance produced by this notation disappointed Tamara also. Amanda, however, repeated the word *cats* in a manner that produced a musical performance that she considered acceptable. She developed the experiment to produce the composition that she chose as her contribution to the class presentation of computer art and music. The beginning of Amanda's composition that she titled "Cats" is shown in Figure 37.

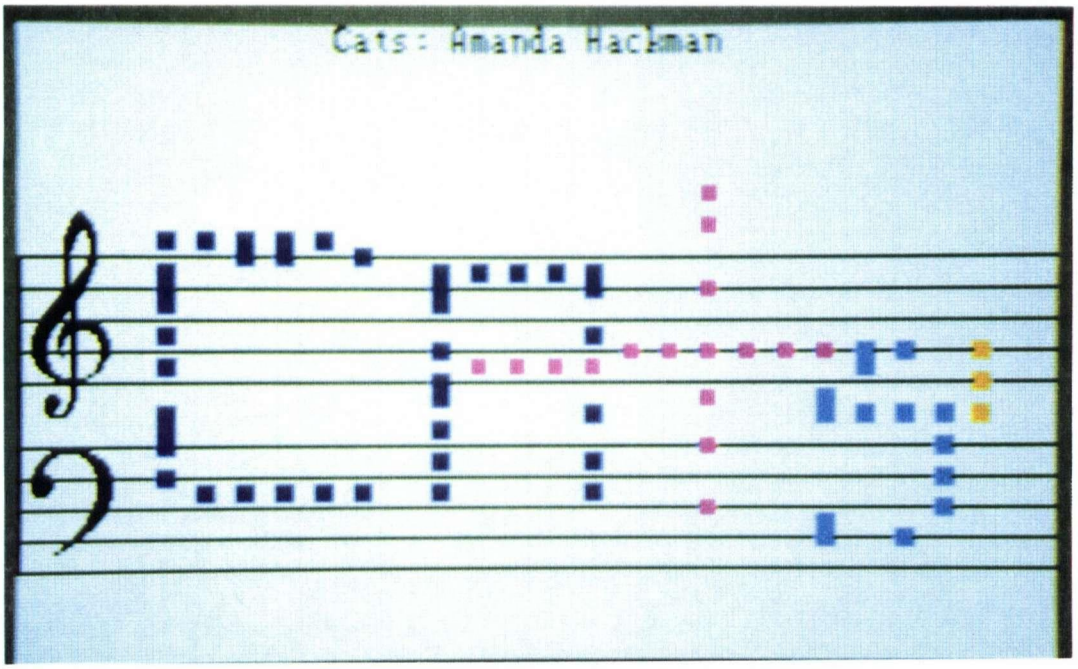


Figure 37. Visual composition. Rectangles that represent notes are used to form letters.

Tony produced a composition that he titled "Houses." Visually, the composition began as two houses that were separated by a line that represented the ground. Several mountain ranges followed, and the composition ended with a tree. Tony was not satisfied with the sound of his initial composition. He repeatedly replayed the work and modified the visual aspects until he was also satisfied with the music performance aspects. He changed the shapes of the houses, added a dog house between two mountains, and put a nest in the tree. Two sections of Tony's composition are shown in Figures 35 and 36. A boy described the ending of the composition in a manner that encompassed its visual-aural nature. He commented, "It sounds like someone cut the tree down." Tony chose "Houses" as the composition to accompany his art images in the multi media presentation, "Sights and Sounds."

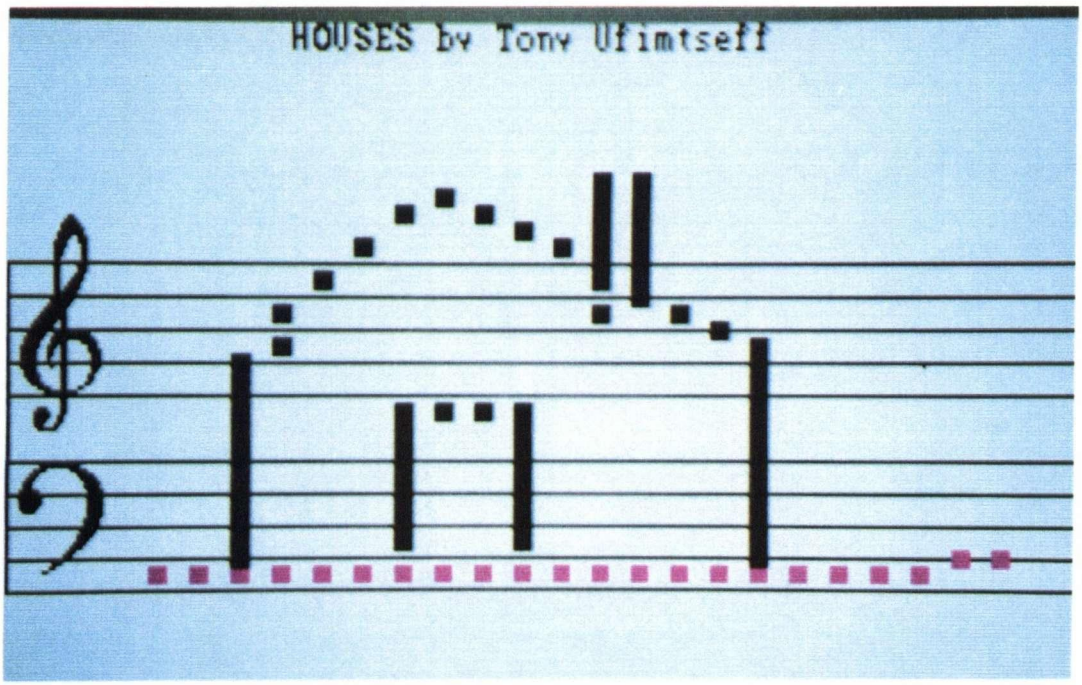


Figure 38. Visual-aural composition. One of the houses near the beginning of the composition.

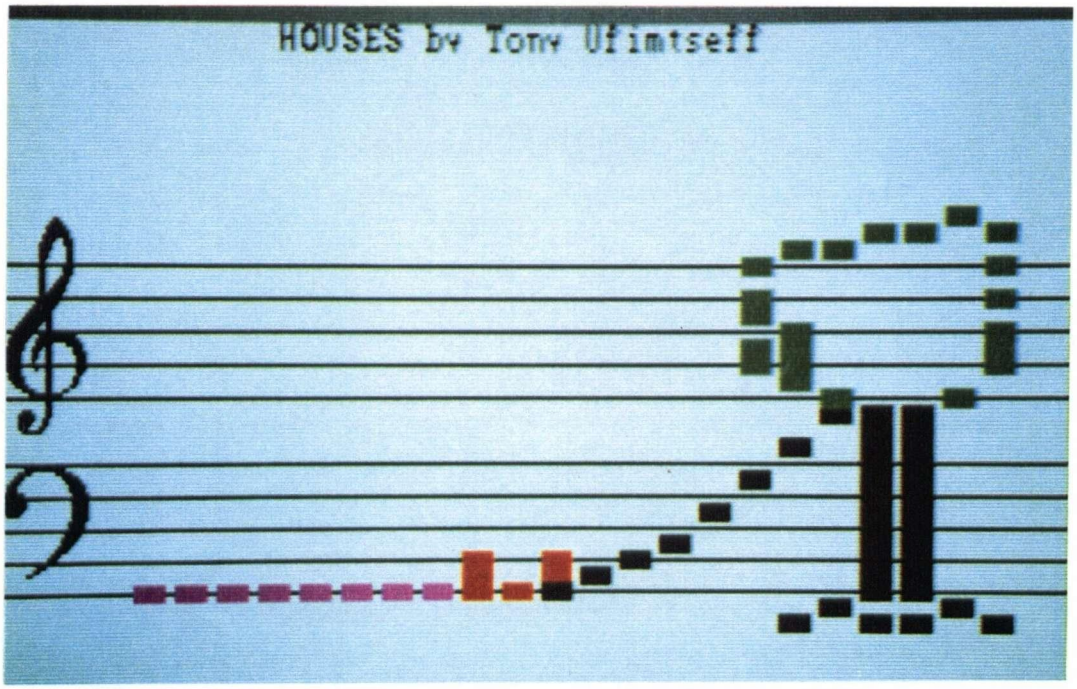


Figure 39. Visual-aural composition. The tree with which the composition ended.

Selection and preparation of compositions for presentation posed one major problem. Each composition needed a duration of 58 seconds to enable the music to synchronize with the automatic slide presentation of each student's four art images. When faced with this time requirement, a few students created new compositions. Most students adapted, or chose sections of, previously composed music. Precise timing was achieved in many cases by slight changes to the performance tempi. No student made a major alteration to the original tempo of a composition. Several students initially tried to increase or decrease tempi of compositions whose original playing times were from five seconds to five minutes. However, when they listened to their altered compositions, they all agreed with the girl who said, "That doesn't sound like what I wrote." All explored and found other ways to comply with the time requirement.

In the preparation of their compositions for presentation, the students demonstrated that their music was important and meaningful to them. They had taken the sounds provided by the computer medium and structured those sounds into music compositions that expressed their conceptions of music. Structure was obvious in the notation of the compositions, and the students and I could identify the structural forms in performance. Comments made by other teachers who heard the students' compositions included the descriptions "incredible" and "mind boggling," but one teacher spontaneously analyzed what she had heard. She said that she had particularly noticed the scale type patterns and the monotone bass ostinati that were used in many compositions.

The progressive steps that led to the creation of the compositions revealed that the students thought of sound in patterned phrase blocks. In these blocks of sound, traditional harmony, melody, and rhythm were not of initial importance in comparison to timbre, texture, and tempo. Of paramount importance to the students was the form of the music.

Summation of Findings

The focus of the research study was on what occurred when grade four students used computers as tools that enabled creative expression in poetry, art, and music composition. The use of computers as creative media in more than a single area emphasized their general applicability as creative tools. The possibilities that students discovered in the word processing, art, and music software programs were explored in relationship to each other and used in ways that demonstrated the students' associative thinking skills.

The use of computers as creative tools was initially unfamiliar to the students. In use of the new medium, the students first randomly explored possibilities. Patterned experimentation with the possibilities that were discovered followed. Students then used the medium to develop completed works of poetry, art, and music.

Although traditional poetry composition required an accepted approach to keyboarding, the capabilities of the word processing program were also randomly explored, and the possibilities that were discovered led to the composition of concrete poetry by many students.

Features of the art program that allowed students to work with colours of their choice and tonal graduation effects supported nonrepresentational image making. Features of the program that provided ease and speed in exploration of variations to visual effects encouraged students to create series of images.

The music program allowed students to choose and arrange elements of music composition and to immediately hear the sound produced. The students used the feature of immediate playback of notated music to guide them as they combined the elements of music into compositions. This unique feature of immediate playback allowed students to compose music in a manner not possible without computer capabilities. Common developmental stages in the composition of music were demonstrated by the students.

During the study, not one student asked me if I considered any aspect of his or her computer generated work to be "good," "okay," or "enough." Reflection concerning the absence of queries that I had heard often from other students in regard to their work led to the realization that these students had made their own judgements on the work that they produced. The students observed on a computer monitor screen the work that they created. They were simultaneously participants and observers and were able to respond aesthetically to their own work. When students responded in this manner, they wanted to share their work with others. Instead of requests for value judgements, the students' requests had been to come and look at, or listen to, what they had created.

Use of computers as creative media actively involved the students in expressive learning experiences. They created poetry, images, and music because such experiences were satisfying. They learned willingly.

A girl summarized the contribution of computers to her learning in the statement, "We usually just did games. This is the first year I got to play on the computers. It's much different." She recognized that the play she had experienced in use of the computers as creative media was distinct from the preprogrammed game playing of her previous experience. She had played, explored, experimented, created, and learned.

There were several implications in the comment of the boy who said, "I'm going to miss it in grade five," but one of those implications was that he too recognized the contribution to learning of computers used as creative media.

CHAPTER 5

CONCLUSIONS

Synthesis

General Learning Outcomes

Grade four students, children of nine and ten years of age, used computers as creative media for composition of poetry, art images, and music, and they learned. The learning that occurred encompassed a broad range of both cognitive and affective educational objectives.

Comparison of cognitive and affective domain taxonomies by Krathwohl, Bloom, and Masia (1964) showed that cognitive objectives contain implied affective components, and that learning in both domains is concurrent. Students in this study demonstrated interrelated learning in both domains. The students used cognitive processes when they learned how to achieve objectives. In the actual achievement of those objectives, they demonstrated affective domain learning and development.

Students displayed interest and positive attitudes while working with, not just learning about, computer word processing, art, and music. They voluntarily pursued activities and conceptualized themselves as artists, poets, musicians, and computer experts. Such actions and attitudes that the students demonstrated indicated that affective learning had taken place. The developmental stage at which value is placed on an activity includes a demonstrated commitment to that activity. Such commitment was shown by individuals and the group in preparation of their computer generated work for presentation. The stage of conceptualization that was attained by many students was at an advanced level in the taxonomy of educational objectives for affective domain learning.

Cognitive learning included the acquisition of knowledge that related to computers and the various subject areas in which the students worked. Students requested and researched information because they wanted knowledge. They were directly, actively, and individually engaged in a learning process when they worked at computers. Knowledge that was needed for the accomplishment of a self-motivated objective was eagerly sought because it was considered necessary and meaningful. Knowledge that the students sought and acquired related to computers; specific elements of art, music, and language; and topics that students chose as bases for

various computer generated works.

A unique aspect of computer generated work, combined with the personal motivation aspect, promoted in students a desire to use correctly such formal aspects of language as punctuation and spelling. Work that was presented on a monitor screen was able to be edited cleanly and rearranged quickly. Visual aspects of the format and presentation of work became important to the students.

Cognitive processing in areas of creative thinking, critical thinking, and problem solving was obvious in the students' use of the computers as creative media. Creative thinking skills were strongly supported by a medium that allowed ideas to be generated and changed quickly. Flexibility was encouraged. Questions that concerned how something would look or sound from a different point of view were easily and quickly answered and usually reversible.

Elaboration, which is recognized as a desirable skill in creative thinking, was also readily achieved in use of the computers. Students added many details to their work. They were also able to remove unwanted elaborations and thus became selective in the details that they retained in finished work. Selective use of elaboration indicated that the students critically evaluated the effects of details. The amount of detailing evident in a student's art work is often used as an indication of a student's level of creative thinking. However, a completed computer image may give no indication of the amount of elaboration actually used by a student.

Fluency was evident in the general prolific output of computer generated work and also in specific outcomes. The many different interpretations of the circles drawn in multi colours and the development of image processing were examples of creative fluency.

Originality was particularly obvious when students experimented with new features or possibilities that they discovered in the software programs. Students used only a small number of the features available in the music software program, and the perspective feature available in the art program was not used. The availability of such a wide variety of features was a desirable aspect of these programs. Individual students were able to work at progressively more complex levels as they felt ready, but they were also aware that much remained to be learned. They set their own goals and willingly worked toward them.

The critical thinking skills of analysis, synthesis, and evaluation were used constantly by the students. These skills required no formal instruction. They developed because the students needed to use such skills to achieve their self-motivated objectives. Every students' work was individual, and therefore every student was

provided different opportunities for the application of critical thinking skills. Relationships between their own work and situations encountered by other students were recognized. Students analyzed problems and organized their solutions. They connected ideas and synthesized them into new inventions that spanned the boundaries of subject disciplines.

The evaluations of work and the value judgements made by the students were not based on critical thinking skills. Evaluations and value judgements were evidence of aesthetic learning. Broudy (1977) claims that the area of aesthetic learning lies between the cognitive and affective domains. Aesthetic learning is recognized as an important aspect in education by many respected scholars and educators including Courtney (1987), Dewey (1934), and Read (1956).

Although the value of aesthetic education has been recognized, there appears to be a lack of tangible practical suggestions for its provision. However, the students who worked with computers as creative media demonstrated that aesthetic learning was taking place. The value judgements that the students made in regard to their own work were based on aesthetic experiences. The display of work on the computer monitor screen allowed the students to be simultaneously participants and observers, creators and perceivers, of their own work. They recognized and responded to artistic forms that they had created. The moment of recognition and response for an individual student was an aesthetic experience. Langer (1957) explained that an aesthetic experience comprised both participation and observation components. The requirements for such an experience were met in the use of computers as creative media. Students demonstrated aesthetic learning in addition to cognitive and affective learning.

Social and Personal Development

Computers are personal media and, in this study, were used in turn by individual students. Concerns were expressed in several studies that individual use of computers could result in isolation of students (Baker, 1985; Bloomfield, 1987). Such concerns proved unfounded in this present study. The use of computers in the classroom setting encouraged cooperative group socialization: an effect that also was observed by Diem (1986).

The students who were involved in the present study displayed interest in each other's work, engaged in many relevant discussions, and learned as they watched their peers work at the computers. Cooperation and the stimulus of shared ideas often resulted in experimentation that was a collective creative process. One student operated the computer, but a group of students collectively provided ideas toward what was created. The

commitment to preparation and presentation of work that was displayed by every student demonstrated exceptional cooperation within the social structure of the classroom.

The personal development of individuals was evident. The students recognized that their computer generated work was of value. They demonstrated self-motivation and a desire to learn by their willingness to use the computer medium, and their enthusiasm extended to use of the computers outside of regular class time. All students were able to produce work that provided personal satisfaction and thereby experience enhanced self-esteem. Students believed their work to be of value, and they wanted others to see, hear, and read what they had created.

Although they had support from peers and teacher, students developed independence because they worked individually. They accepted responsibility, not only for the organization of their computer generated work, but also for the organization required to combine other classroom commitments with class time spent in computer use.

Teachers have indicated concern that they could become redundant because of the introduction of computers as educational media (Menis, 1987). The present study indicated that teacher redundancy resulting from student use of computers was unlikely. The role of the teacher was demonstrated to be of utmost importance to facilitate, support, and direct the learning of students as they worked with the computers.

Approaches to Learning

The developmental learning stages of children have been documented and described in various terms and subdivisions (Bolton, 1979; Holt, 1983; Inhelder & Piaget, 1958; Kellogg, 1970; Lansing, 1976; Lowenfeld & Brittain, 1982; Viola, 1944). All such documentations reveal a general recognition that play leads to experimentation which in turn leads to use of a new learning.

The students who were involved in this present study demonstrated the same general development, not only in their use of computers as creative media, but in their approach to each new aspect that was discovered. They randomly played, proceeded to patterned experimentation, and then used the new learning. The importance of initial play as an approach to learning was obvious as the students composed poetry, art images, and music.

The students then experimented with possibilities that they had discovered through play. Repetition of keyboard symbols, designs that used geometric shapes in every palette colour, and repeated scale patterns were

some of the ways in which the students demonstrated experimental patterned use of their discoveries. During their search for schemata with which to represent ideas, the students gained control and understanding which enabled them to consciously use new learnings. The manner in which many students then used the computers as media in creation of poetry, art images, and music revealed a natural inclination to abstract expression.

Developmental progression to the abstract is recognized in thought processing (Inhelder & Piaget, 1958) and drama (Bolton, 1979). However, developmental stages in art have been described as a progression from the stage of representational schemata to that of increased naturalistic realism (Lansing, 1976; Lowenfeld & Brittain, 1982; Viola, 1944). No consideration has been given to the development of nonrepresentational art expression that was observed in the image making of the students who participated in this present study.

There also appears to be a lack of information that pertains to spontaneous composition of poetry and music by students of grade four age. Language development of students is usually directed toward increasingly correct usage of grammar, syntax, spelling, and punctuation. Poetry composition is often modeled on traditional forms and concerned with use of language in recognized poetic devices. Music composition by nine and ten year old children has been severely restricted because of the complexities of formal notation and the problems that are encountered in performance of the music that is composed.

Computers used as creative media enabled children of nine and ten years of age to spontaneously compose poetry, art images, and music. The manner in which such compositions were approached and the works that were created indicate that the students learned and worked with the traditional elements and principles of language, art, and music in nontraditional manners.

Visual forms of expression in the genre of concrete poetry were created. Image making was primarily nonrepresentational and abstract. Images incorporated overlapping elements that used tonal gradations to provide depth, light and shade, and perspective. Sophisticated use of monochromatic palettes was demonstrated. Music compositions were structured sound that employed all elements of music but were nontraditional in use of melody, tonal centres, and rhythm.

Readily apparent in all computer generated poetry, art, and music was the predominant use of form in creative expression.

Expression Through Form

In their search for suitable ways to express their ideas, students concentrated primarily on form in the

works of poetry, art, and music that they created. The students demonstrated an innate sense and recognition of the element of form in compositions. Other elements of language, art, and music were incorporated into the form of compositions as individual students explored and discovered their applicability.

Form embodies a network of elements and is thus the element through which all others can be explored and learned. The students appeared to recognize the importance of form and naturally worked through this basic element. They perceived whole compositions in forms that made use of various other elements as parts that comprised the whole.

Computers as media provided the flexibility, speed, and ease of use that enabled children of nine and ten years of age to search for and achieve forms that they found personally satisfying as they created poetry, art images, and music.

Implications

This study researched the use of microcomputers as creative media in fine arts. The findings indicate that computers are valuable educational tools when used as media that enable creative expression by students of nine and ten years of age. The unique capabilities of the computer medium provided learning opportunities that are not readily available in use of other media in classroom situations. Of particular importance is the realization that computers are able to provide opportunities for affective domain growth and aesthetic experiences as well as cognitive learning.

The students' use of form as a natural approach to learning indicates that consideration of this element is necessary in selection of teaching strategies and materials that are used in classrooms. The whole language approach to language education that is in process of implementation in many British Columbia schools proceeds from an experience with language to an examination of its component parts. Such an approach encourages an awareness of language forms, which include the various forms of poetry, and is thus compatible with the perception of form demonstrated by the students who participated in this reported study.

Teaching strategies that are used for art and music education should also provide opportunities for students to work through form as opposed to work that is concentrated on single elements such as line or rhythm. Some current practices in music education that have developed from Kodaly's philosophy could perhaps be examined. Teachers need to be aware that children naturally recognize phrase structure as musical

form and ensure that other elements of music are taught in relation to the element of form.

Play is recognized as a developmental stage in the learning process of young children but is given less consideration as a necessary learning stage for children as they progress through school. The nine and ten year old students who participated in this study demonstrated the importance of play as an initial step in their approach to a new medium and new concepts. Consideration could be given to the amount of time that is allowed for play and random exploration by students when new materials and concepts are introduced. The findings from this study indicate that play is a necessary and valuable stage that permits and encourages self-motivated learning.

The abstract nature of the majority of images that were created by the students suggests that there could be an unexplored area in children's art development. The usual expectation is that children will progress toward increased realistic representation. Such expectations can cause some children to consider themselves incapable of image making. Students who participated in this reported study expressed no concerns about their artistic abilities, and all students achieved personally satisfying images.

Computers used as creative media in a classroom setting promoted a positive learning atmosphere. Students accepted responsibility for their own learning, displayed cooperation as they assisted their peers, and demonstrated pride in their individual and group efforts. The unique capabilities of computers proved highly motivational to all students. They willingly explored and learned as they used the computers as tools that enabled creative expression through poetry, art, and music.

Recommendations

Several areas for further research are suggested by the findings from this study. Computers used in the classroom promoted many positive learning outcomes and proved suitable as creative media in fine arts education. The students used the unique capabilities of computers to compose poetry, art, and music in ways that previously were not possible. Because of this, several aspects developed that merit further detailed study.

The students displayed associative thinking skills in their use of the different software programs. The extent to which children are able to link and associate ideas is important in the move toward interdisciplinary education and therefore research in this area is indicated.

Word processed creative writing followed the developmental steps of the writing process as described by

Graves (1980). However, the steps of editing and proofreading appeared to be accomplished more easily and with greater speed than when notebooks and pencils were used. A closer study of the relationship of computer word processing to the writing process could prove to be a useful area for investigation.

The nonrepresentational image making that was supported by use of the computer medium is an unexplored area. The development of such a style provided all students in this study with a satisfying form of art expression and thus enhanced self-esteem and motivated learning. Observation of other children of various ages could ascertain whether or not the development of a nonrepresentational art style is usual when computers are used as media.

Children have been restricted in their choice and use of colours for image making because crayons and pencils are available in only certain standard colours and paints often combine in use to produce unexpected and unwanted results. The computer medium allowed children to select from a range of more than 4000 colours and to use those colours precisely. The students in this study used subtle shades and tints of two or three colours and monochromatic palettes for image making. Such observations suggest that specific study of the use of colour by children could prove interesting.

The software program that was used during this study did not visually present all available colours but required that each be obtained by either of two mixing methods. Varying amounts of red, green, and blue could be mixed to produce a desired colour, or a hue could be selected and its saturation and value adjusted. All colours could be generated through random exploration. However formal operational thought processing was necessary to consciously generate desired colours. Children of nine and ten years of age generally have not developed the ability to systematically explore all possible permutations. No attempt was made during this reported study to ascertain the manner in which the children obtained the colours that they used. Observation of this aspect could provide insight into the extent of formal operational thought of which children of this age are capable.

The unique capabilities of computers enabled children to compose and perform music compositions in a manner that previously has not been possible. There are indications from the findings of this study that children demonstrate common approaches to the use of the elements of music and definite developmental stages in music composition. Further detailed investigation of computer music composition by children of various ages is needed to extend understanding of children's spontaneous composition of music.

Many schools have established computer laboratories which permit all students from a classroom to work simultaneously with computers. Such placement of a school's available computers could preclude the use of a few computers in an individual classroom as was the situation for this reported study. Investigation could be undertaken to ascertain whether or not the use of computers in a laboratory setting promoted positive social and cooperative behaviours similar to those observed in the students who used computers in a classroom setting.

The constant and close involvement with data collection that was necessary during this ethnographic research study suggests that classroom teachers are in ideal positions to undertake research that pertains to educational matters and requires interaction with students. Educational authorities such as school boards could recognize the potential contribution of classroom teachers to educational research and encourage teachers to undertake needed research through provision of support personnel. An assistant teacher or qualified aide could relieve the time constraints that are encountered when regular classroom duties are combined with a research study.

Concluding Remarks

The use of computers as creative media by grade four students permitted many positive learning outcomes. The students became personally involved, demonstrated enthusiasm, and accepted responsibility for their own learning when they used computers to create poetry, art, and music. Peer interaction and cooperation in use of the computers promoted a positive learning environment.

The expressed desire of the students to present their computer generated work to a wider audience gave evidence of the self-esteem developed by individuals and the group as a whole.

Valuable insights into the manner in which children approach the creation of poetry, images, and music were gained. The capability of students to associate and integrate interdisciplinary concepts also was revealed. The combination of computers and the fine arts provided valuable learning opportunities for grade four students. The eager acceptance of learning opportunities that was demonstrated by the students who participated in this study is probably not restricted to children of their ages. Microcomputers can be considered valuable additions to the standard creative media that are currently used in fine arts education.

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APPENDIX E

Fine Arts Affective Domain Development Survey

FINE ARTS SURVEY

Your responses will help your teacher to understand how you feel about some of the things we might do at school this year.

NAME: _____

How do you feel about doing each of the following ?

	I don't know what this means.	I really don't want to do this.	I'm willing to try this.	I'd really like to do this.	I'll be doing this anyway.
EXAMPLES					
A. Solve some math problems.					
B. Study a novel.					
I. Compose a song.					
2. Sing with a group at a concert.					
3. Listen to a visiting choir.					
4. Listen to music by well known composers.					
5. Make a sculpture.					
6. Create some drawings or paintings.					
7. Look at some famous paintings.					
8. Visit the art gallery.					
9. Create movements to music.					
I0. Dance a folk dance.					
II. Watch a dance group perform.					
I2. Work out the meaning of a dance.					
I3. Choral speak with a group.					
I4. Write some of your own poems.					
I5. Read some poems.					
I6. Listen to authors read their original poems.					
I7. Play at being someone else.					
I8. Act in a play.					
I9. See a performance of a play.					
20. Observe and imitate people and things.					

APPENDIX F

Raw Score Data From Fine Arts Survey

FINE ARTS AFFECTIVE DOMAIN DEVELOPMENT SURVEY

STUDENT	SCORE	SUBSCORES								
		ART	DANCE	DRAMA	MUSIC	POETRY	EXPR. ITEMS	IMPR. ITEMS	ODD ITEMS	EVEN ITEMS
BOYS										
A	43	10	5	9	9	10	22	21	21	22
B	34	8	5	7	7	7	18	16	16	18
C	46	12	6	12	4	12	22	24	24	22
D	48	10	10	11	8	9	25	23	23	25
E	48	10	4	12	10	12	26	22	26	22
F	33	9	6	5	8	5	17	16	16	17
G	38	9	5	7	8	9	17	21	17	21
H	29	7	3	8	5	6	15	14	14	15
I	52	14	7	12	11	8	20	32	27	25
J	42	10	8	9	9	6	22	20	23	19
K	21	4	4	5	5	3	7	14	9	12
L	38	12	6	6	9	5	18	20	20	18
M	21	6	4	3	3	5	9	12	9	12
N	30	10	4	8	4	4	14	16	14	16
O	25	8	4	5	4	4	12	13	12	13
P	16	3	3	5	1	4	9	7	8	8
Q	49	12	6	11	11	9	22	27	23	26
GIRLS										
A	48	12	10	10	7	9	24	24	24	24
B	38	12	8	6	5	7	17	21	19	19
C	20	6	4	4	2	4	11	9	10	10
D	46	9	10	9	11	7	25	21	25	21
E	40	11	7	9	7	6	22	18	19	21
F	52	12	8	11	10	11	24	28	25	27
G	48	10	8	11	10	9	23	25	27	21
H	43	11	9	7	8	8	19	24	22	21
I	48	11	10	9	10	8	20	28	23	25
J	56	10	13	8	12	13	27	29	25	31
K	49	12	14	10	9	4	25	24	25	24
L	27	7	6	5	3	6	15	12	14	13
M	33	12	5	8	4	4	17	16	18	15
N	55	12	10	10	12	11	28	27	28	27
TOTALS	1216	301	212	252	226	225	592	624	606	610
MEANS	39.23	9.71	6.84	8.13	7.29	7.26	19.1	20.13	19.55	19.68
STDV	11.23	2.57	2.85	2.57	3.12	2.79	5.62	6.23	5.97	5.57

BOYS	N=17	
	RAW SCORE TOTAL	613
	MEAN	36.06
	STDV	11.11
GIRLS	N=14	
	RAW SCORE TOTAL	603
	MEAN	43.07
	STDV	10.5

APPENDIX G

Computer Questionnaire

COMPUTER QUESTIONNAIRE

Answers to these questions will help your teacher to understand your previous experience with computers.

NAME: _____

Is there a computer at your house ? YES___ NO___

Have you used the computer at your house ? YES___ NO___

What have you used it for ?

_____

How often do you use the computer at your house ?

____ every day
____ a few times a week
____ about once a week
____ less than once a week

Have you used a computer at school ? YES___ NO___

What have you used it for at school ?

_____

Have you been taught keyboarding ? (to type using the correct fingers) YES___ NO___

Have you typed on a computer keyboard ? YES___ NO___

How fast can you keyboard ?

____ faster than I can write or print
____ about as fast as I can write or print
____ slower than I can write or print

Would you like a computer of your own ? I HAVE ONE___ YES___ NO___

Did you, or would you give it a name ? YES___ NO___

What did you, or would you call it ?

_____

How do you feel, or what do you think about computers ?

_____

APPENDIX H

Examples of Music Software Reference Cards

MUSIC STUDIO 2.0

PLACE NOTES – PLAY – ERASE 1.

How many pull down menus can you find? ANSWER →
How many pop up menus can you find? ANSWER →
Select any NOTE.
Click to place notes on staff lines and in staff spaces.
ERASE by clicking on top of note.
Click on left song slider box to get number 1.
PLAY

a) Click → 

b) Click → 

What is the difference between clicking these two symbols ?

ERASE EVERYTHING – double click the trash can.
Select other notes, place them where you want.
Play your music.

MUSIC STUDIO 2.0

INSTRUMENTS 2

Select and place notes on staff.
Play.

Select a different INSTRUMENT 

Place more notes on staff.
Play.

Try selecting and using every instrument.

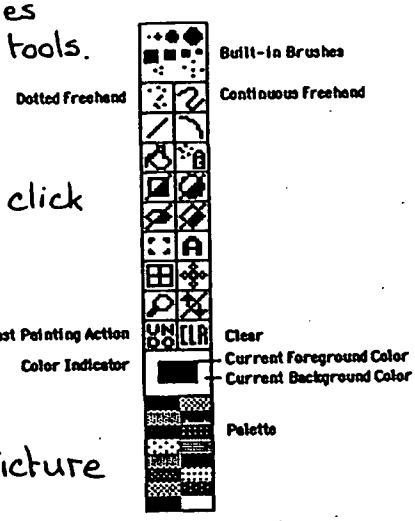
APPENDIX I

Examples of Art Software Reference Cards

DELUXE PAINT II

BRUSHES - FREEHAND LINES - COLOURS 1

Click to select one of the ten brushes
Click to select one of the two freehand tools.
Use the mouse to draw.
Change colour. Click on the palette.
Click CLR to clear screen.
Change background colour – Command click palette colour. Click CLR.
Try every brush with both line tools.
Did you make a mistake?
Click UNDO before you click anything else.



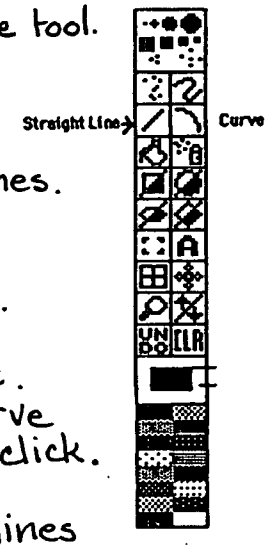
PROJECT: Draw a design or a picture using just the brushes and tools you've practised.

DELUXE PAINT II

STRAIGHT LINES – CURVES 2

Click a brush, a colour, and the straight line tool.
Move + to beginning of line.
Press mouse button and drag to end of line.
Release the button.
Use different brushes and colours. Draw more lines.
Clear. Choose a new background colour.

Click a brush, a colour, and the curve tool.
Move + to beginning of curve.
Press mouse button and drag to end of curve.
Release button. Move mouse. Watch curve change. When curve is how you want it, click.



PROJECT: Draw a pattern using straight lines and curves.

APPENDIX J

Examples of Keyboarding Practice Reference Cards

a - s - d Space Bar 1	l (a-s-d-f) Space Bar 3
as add dad sad dads	all fall lad lass lads falls salad salads
f (a-s-d) Space Bar 2	**k (a-s-d-f l) Space Bar 4**
fad fads	ask asks flask flasks

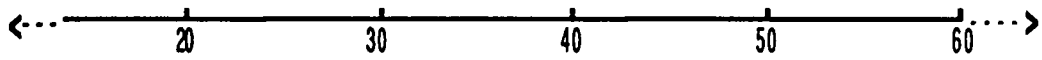
h (a-s-d-f k-l) Space Bar 5	j (a-s-d-f g h k-l) Space Bar 7
had has hall ash dash lash sash flash half	jag jags
g (a-s-d-f h k-l) Space Bar 6	**r (Home row) Space Bar 8**
gag gags sag sags lag lags gas flag flags glad glass	far rag ark dark lark larks hark shark sharks lard hard jar jars

APPENDIX K

Individual Student Profile Form

PROFILE: Birthdate: Gender: September 1988

Fine Arts Affective Domain Development Survey Raw Score:

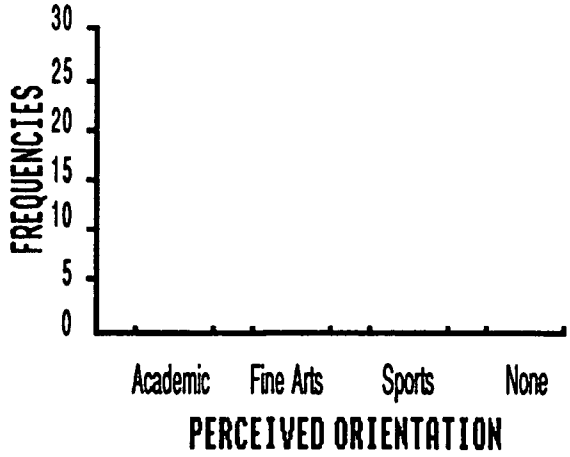


Aware ----> Willing to Receive----------> Deriving Satisfaction ---------->

Population: N = 31 Score Range = 41 Low score = 16 High score = 56

Mean = 39.23 Median = 42 Mode = 48 Standard Deviation = 11.23

Orientation Toward Academic, Fine Arts, Sports, or None of These, as Perceived by Peers and Self



Perceived by peers as student possessing greatest orientation in this area.

* Percieved self as possessing greatest orientation in this area.

Out of School Activities

Lessons:

Group Memberships:

Computer

Attitude:

	Yes	No	Application
Computer at home			
Has used computer at school			
Instructed in keyboarding			
Computer keyboarding experience			

APPENDIX L

Computer Time Log Sheet

COMPUTER USE LOG

DATE	NAME	A = Art M = Music W = Word Process SOFTWARE	IN	OUT	TIME SPENT
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	
			:	:	

APPENDIX M

Informal Observation Sheet

MICROCOMPUTERS AS MEDIA IN FINE ARTS EDUCATION

INFORMAL OBSERVATION BY PAMELA HUGHES DATE: _____

WHEN	WHAT	WHO	COMMENTS

WHEN

A. Before a.m. class
B. Class before recess
C. Recess
D. Class after recess
E. Lunch
F. Class p.m.
G. After p.m. class

WHAT

K. Keyboard practice
WP1. Word processing prose
WP2. Word processing poetry
A. Art
M. Music

WHO

x Operator

APPENDIX N

Formal Observation Sheet, Page 1

Page 2 of the formal observation sheet repeated only the column headings and allowed the remainder of the sheet to be used for notation of observations.

MICROCOMPUTERS AS MEDIA IN FINE ARTS EDUCATION

Observer: Pamela Hughes

Observation No._____ Date: _____

MECC Word Processing Deluxe Paint II Music Studio

Apple IIe Apple IIGS

Student: _____

Spectators: _____

Screen Display: Comments: _____

TIME	ACTION	VERBAL