A COMPUTER INTEGRATION MODEL FOR LABORATORY COMPUTING TEACHERS IN THE ELEMENTARY SCHOOL: A DELPHI STUDY

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PREFACE

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

Elementary school students have been gradually introduced to computers over the past five years. However, due to insufficient classroom computer equipment and inadequately trained teachers, the successful implementation of this technology has been questioned (Becker, 1983, 1986). In 1983, every elementary school consisted of approximately one computer and approximately two computer-using teachers. A survey conducted in 1985 (Becker, 1986) indicated that the number of computers in the elementary school had more than quadrupled while computer-using teachers had tripled. Becker (1986) identified these computer-using elementary teachers primarily as regular classroom teachers.

Teachers earning elementary education degrees several years ago were not trained to use computers as a tool for enhancing instruction (Wright and Ancarrow, 1986). Within the last five years, the majority of colleges and universities have initiated at least one mandatory "computers in education" course for all prospective teachers (Wright and Ancarrow, 1986). Most initial coursework at the precollege level as well as inservice opportunities were very introductory and did not focus on how to integrate the use of the computer as an instructional tool within the elementary curriculum (Randall, 1985). The literature

designed for learning how to use microcomputers in the classroom has rapidly expanded, but still has not specifically addressed the needs of the laboratory computing teacher in the elementary school.

Elementary schools have primarily used computer assisted instruction for enrichment purposes while offering no indication as to how it has correlated with the elementary curriculum (Becker, 1983, 1986). As computer equipment became more prevalent, computer laboratory environments began to emerge in the schools. Based on this investigator's research into educational computing in the State of Oklahoma, in some instances, as a result of the acquired hardware, a new position developed for a full-time elementary laboratory computing teacher. The teachers assigned to this position showed an interest in computing although they possessed little or no expertise for the assignment. In most cases, they received no guidance related to curriculum goals and objectives or to classroom teaching techniques or activities. Some sought help from other computer-using educators and made attempts to establish a computer curriculum appropriate for elementary students.

A variety of computer learning environments have existed in elementary schools. The predominant types have included a classroom with one computer, a classroom with several computers, or a classroom designated as a computer laboratory. For those schools with laboratory computing teachers, the computing content has been varied and inconsistent from school to school (Becker, 1986). Computer assisted instruction has been the primary activity taught within the elementary computing curriculum. Periodically, programming and perhaps computer awareness concepts were included as topics for instruction. Other

computer teachers have included such topics as software use and evaluation, word processing and use of the computer as a tool for problem solving (Becker, 1986).

Few elementary school computer programs have correlated any of the computer activities or learning experiences to the existing elementary curriculum (Gardner, 1986). The potential for the laboratory computing teacher to relate various computing content areas to language arts, mathematics, science and social studies has not been addressed. For example, students could learn to use a word processing software program while simultaneously working on a language arts poetry-writing unit. Students could be taught to use an electronic spreadsheet program as they learned how to mathematically budget their weekly allowance. Presently, the majority of elementary teachers assigned to teach computing coursework in their particular schools are not accessing the full potential of the technology as an educational tool to enhance the content taught in language arts, mathematics, science, and social studies at the elementary level (Oman and Willson, 1986).

Need for the Study

In the past ten years, elementary teachers have been presented with several types of models to effectively integrate computers into the classroom. Bitter (1984) developed one of the first models describing a content outline for a K-12 computing curriculum. Some of the content areas designated for elementary students included computer awareness, computer programming, applications of computers, and computer operations. Each content area

progressed by skill level throughout the grades. Bitter's model represented an ideal for any elementary school, but initial complete implementation was impossible for the newly-assigned computing teacher due to the extensive nature of the model and the inexperience of the new teacher.

The components of most existing computing models were varied and reflected a different perspective for classroom integration. Although consistency was found for using the computer as a learning tool, implementation of the models demonstrated little uniformity. For example, the State of Minnesota developed fifteen demonstration sites across the state (Randall, 1986). Each site devised its own objectives relative to the district goals. The California State Department of Education took an initial step in implementing a computing model through their Technology in Education (TIC) projects (California State Department of Education, 1986). This work was designed to assist classroom teachers who used technology to enhance and extend their existing curriculum. The Alaska State Department of Education also produced two curriculum guides that were intended to serve as a model to assist school districts with the implementation of computer education (Alaska State Department of Education, 1985). These models listed topics, concepts, learning outcomes, and sample learning objectives for elementary and secondary educators.

Of the models mentioned, some had focused on single or dual combinations of content areas such as programming in BASIC or LOGO, computer careers, computer awareness, and computer ethics. From the perspective of a laboratory computing teacher, most of these less comprehensive models have not focused on the specific objectives to be implemented for each

computing content area. Recognizing this potential deficit, Oman and Willson (1986) outlined an example appropriate for K-8 computing curriculum needs. Computing content areas included within the model were applications, careers, history and resources, problem solving methods, programming skills, social and ethical issues, structure and function, and vocabulary/general concepts. Each area had been described by a set of objectives that could be applied at the elementary level. In addition, the model could also be adapted to fit the needs appropriate to different grade levels.

None of the elementary computing curriculum models identified in the literature have addressed how this computing content is related to the existing elementary curriculum in language arts, mathematics, science, and social studies. In several cases, objectives specific to the content areas were listed, but no indication was made as to its relation (if any) to elementary curricula. There exists a need to develop a comprehensive computing integration model that can be adapted to the elementary grade levels for laboratory computing teachers. In addition, this model needs to focus more specifically on the computing content areas identified by the literature as general operations/concepts, problem solving, applications, careers, programming skills, history, social/ethical issues and telecommunications. Finally, in order for computer learning activities to enhance and compliment the traditional elementary curriculum, a model is needed to identify how the computing content areas can be integrated into existing language arts, mathematics, science, and social studies curriculum.

Based on the review of literature, there exists a need to form a consensus concerning what computing content areas should be taught in the elementary

curriculum. As these computing content areas are identified, there also exists the need to investigate the topics and types of curriculum integration activities that the laboratory computing teacher would use to deliver the computer instruction. Based upon these needs, this study was designed to formulate a computing content model that could be utilized for establishing guidelines and planning curriculum in elementary school computer programs. The findings of this study will assist elementary laboratory computing teachers, curriculum coordinators, and other teacher educators in directing their efforts in building a laboratory computer curriculum and in preparing elementary teachers toward meeting students' needs more effectively.

Purpose of the Study

The purpose of this study was to reach a consensus among recognized educational computing experts concerning the development of an effective computer curriculum integration model that could be utilized by laboratory computing teachers in grades K-8 to assist with the implementation of computer education throughout the total curriculum. Because no established research base existed relative to the use of computers in a laboratory setting at the elementary level, the investigator, through use of a national Delphi study, sought the collective opinion of experts in the field.

The major research questions were:

1. What are the specific computing content areas that can be used to support the computing instruction provided by an elementary laboratory computing teacher?

2. For the elementary laboratory computing teacher, what topics best support the computing instruction for each identified computer content area? and
3. What types of instructional laboratory activities best support the selected topics for each computing content area and also integrate across the traditional elementary content areas of language arts, mathematics, science and social studies?

For laboratory computing teachers, the development of a K-8 computer integration model that correlated the specific computing content areas with the traditional elementary subject areas is unique. Using the Delphi technique, this model was developed by a consensus from leading educational computing experts. This research procedure was modified to accommodate the specific needs of this study.

This study provides an empirical base of information for elementary laboratory computing teachers, curriculum developers and teacher educators. The model can be used by any elementary laboratory computing teacher who is attempting to build a computing curriculum that enhances language arts, mathematics, science, and social studies. The distribution of the K-8 computer integration model will enhance staff opportunities focusing on a standardization of computing curriculum taught, in addition to integration activities that can be used to enrich the elementary curriculum.

Implications and recommendations will be discussed related to: (a) the computing content areas that need to be included to enhance a standardization of computing instruction at the elementary level for laboratory teachers; and

(b) the integration topic and activities that can be used to support elementary instruction in language arts, mathematics, science, and social studies.

Assumptions

1. The participants are a representative sample of the educators identified as experts in elementary computing.
2. All of the experts have adequate time, acceptable written communication skills and are motivated to take part in the study.
3. The participants recognized as computing experts are capable of identifying computing content areas and identifying topics and activities according to how they support the elementary curriculum.
4. Elementary teachers who teach computing full time in a laboratory setting are in need of a computer integration model that describes how computers can be effectively integrated across the traditional curriculum areas of language arts, mathematics, science, and social studies.

Limitations

The study was limited to an initial sample of fourteen educational computing experts across the nation. However, during the first and second stages of the study, three subjects withdrew from participation.

A second limitation was the nature of the Delphi technique itself. Delphi requires high participant motivation since other individuals are not present to stimulate and maintain motivation.

Definition of Terms

Content area topics – instructional areas of study that relate to specific computer content areas

Curriculum integration activities – classroom activities that correlate with topics from the content areas.

Delphi technique – a group process which seeks the consensus of opinions of experts by utilizing written responses as opposed to bringing individuals together.

Elementary computing content areas – subject areas that are unique to the curriculum and instruction of computers in education, appropriate for elementary students (K-8).

High Support – one of the two general classification terms used to solicit information from the experts in reference to their preference of computing topics and activities.

Low Support – one of two general classification terms used to solicit information from the experts in reference to their preference of computing topics and activities.

Ranking Scale – a 5-point continuum ranging from a numerical value of one to five.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Moursand (1983) stated that over the next two decades, educators will come to realize that computers are equivalent to reading and writing, or to arithmetic, as part of the "basics" of education. Students who receive an education fully integrating computers as a tool for instruction, problem solving, and personal use, will have a tremendous advantage over those who do not. Educational leaders and the general public will come to expect that schools will provide these educational experiences for all type of students.

Taylor (1980) and Luehrmann (1982) have adopted a focus on student learning as related to instructional technology. They have illustrated some of the techniques that might be used to facilitate this learning. Taylor has used the terms "Tutor", "Tool", and "Tutee" when describing the way computers might be used in the schools. These terms imply that the computer can be used as a "Tutor" for teaching students, as a "Tool" for students to use as they would other educational tools, and as a "Tutee" for students to teach. Luehrmann (1982) has also expressed these same ideas in a slightly different way. He envisioned the three roles to include "learning from the computer", "learning with the computer", and "learning about the computer".

In the past ten years, elementary teachers have been presented with several types of models to integrate computers into the classroom. Bitter (1983) developed one of the first models describing a course content outline for a K-12 computing curriculum. Various State Departments of Education (California, 1986, Alaska, 1985) have produced models for elementary computing instruction. However, none of these models have identified how instruction was to be accomplished for a full time laboratory computing teacher who integrated computing instruction across the regular elementary school curriculum areas of language arts, mathematics, science and social studies. Based on the review of literature, a consistent basis for building a K-8 computer integration model with appropriate computing content areas, topics and curriculum integration activities have not been established for the laboratory computing teacher.

This study will investigate the problem presented. A modified version of the Delphi technique will be used to gain a consensus of opinion to construct a computer integration model for laboratory computing teachers. The review of the literature will (a) focus on educational uses of the Delphi technique as a problem solving process to build a consensus of opinion and (b) identify studies, projects and activities that reflect the current impact of educational computing in elementary schools.

Educational Uses of the Delphi Technique

As the involvement of others in managerial planning has increased, a variety of innovative techniques for management have been introduced. Zero-based budgeting, management by objectives, program evaluation review

technique, and planning program-budgeting systems are illustrative. One of the most successful of these has been the Delphi technique (Brooks, 1979). The Delphi technique is a group planning process which attempts to improve our vision of the future (Delbecq, Van De Van, & Gustafson, 1975). This technique was first devised in the 1950's by the Rand Corporation. Physicist Norman C. Dalkey and futurist Olaf Helmer (Dalkey, 1967), originally created the technique in an effort to elicit and refine the opinions of a group of experts regarding urgent defense problems without having face-to-face discussions. The Delphi process is based on the premise that a group decision is more desirable than that of an individual. This mode of controlled interaction among the respondents not only means savings in time and money, but also permits independent thought among participants and assists them in the gradual formation of a considered opinion. It has the added advantage of ensuring participants' anonymity.

In practice, the Delphi technique has taken on diverse formats in different institutions and settings for different objectives and goals. The most frequent of these applications in education has been in projecting future goals (Brooks, 1979). The exact form of the Delphi is usually governed by the nature of the problem, resources, and the people implementing the program (Henges and Hosokawa, 1980).

The Delphi technique is primarily a series of questionnaires which address a number of objectives to: (1) determine and develop a range of possible program alternatives; (2) explore or expose underlying assumptions or information leading to different judgments; (3) seek out information which may generate a consensus on the part of the respondent group; (4) correlate

informed judgments on a topic spanning a wide range of disciplines; and (5) educate the respondent group as to the diverse and interrelated aspects of the topic (Dalkey, 1967). Three conditions are necessary for a successful Delphi (Belbecq, Van De Van, Gustafson, 1975): (1) sufficient time, (2) skills in written communication and (3) motivation among the respondents. Since the Delphi requires individuals to respond within a specific time period (a minimum of approximately 45 days), the respondent group needs to demonstrate a willingness to take part in the study, be proficient in written communication skills and motivated to continue the process to completion. One of the strengths of the Delphi process is that it provides a consensus as well as a range of opinions.

While the Delphi technique was originally developed for the purpose of future forecasting, it has been used in modified forms in educational settings which focus on what participants would like to see happen, rather than on what is likely to happen (Hartman, 1981). In an attempt to review the district's existing program for gifted and talented students, the Paramus, New Jersey Public School system utilized a modified Delphi process. For curriculum-building purposes, experts of the study consisted of classroom teachers, enrichment teachers, specialists, parents, and students (no principals initially responded to be active participants, but their input was later included). The standard Delphi process used a series of questionnaires based upon broad, general questions initiated in the first questionnaire. The second questionnaire, which is a compilation of first questionnaire responses, required participants to further refine the gathered information. The third round followed a similar procedure and brought the task to completion.

Two modifications from this standard process were indicated by the uniqueness of the problem faced by Paramus Public Schools (Hartman, 1981). As a basis for the technique, rather than using broad questions that represented possible future developments, the first questionnaire contained a chart of twenty school district policy statements. These statements represented key issues between the two groups in conflict with the gifted and talented program proposals. Those not agreeing with the statements were asked to specify in the first phase the change they would accept. The second modification appeared in questionnaire two and involved several revisions to the original chart in questionnaire one. Changes were based upon respondents' comments and provided clarification to the original questionnaire.

A modified Delphi process was also utilized in the Suffolk Public School System (Virginia) as a needs assessment technique in a school-wide reading program (Morgan and Griffin, 1981). The purpose of using a modified Delphi study was to determine how teachers and paraprofessionals perceived reading goals that were mandated by the reading resource person. Small groups of teachers and paraprofessionals met with a mediator to discuss the perceived needs of the reading program. The results compiled from these meetings provided the basis for the first of two questionnaires. This first questionnaire was sent to teachers, professional educators and community members. Respondents were asked to rank items in hierarchal fashion using a one to five summated rating scale. Results of Round 1 were tabulated and distributed to all respondents through questionnaire two. Participants prioritized the rankings and returned their surveys. The results of this modified Delphi study ultimately

provided inservice educational reading programs centered on the needs that teachers had identified as significant.

A Delphi study was utilized by the Missouri Department of Elementary and Secondary Education in an effort to involve teachers in the planning and development process of a new health education curriculum (Hentges and Hosokawa, 1980). Using the Delphi results, directions for school health education were plotted and a curriculum guide was written. It reaffirmed the direction, focus and curriculum contents in addition to expanding the possibility of a higher rate of successful integration.

Since the Delphi technique has been used to generate consensus on issues of importance, the process offers an efficient and effective means of determining goals and objectives in a wide range of educational environments. Toward that end, issues have been identified (Questionnaire One), clarifications, supportive statements, and criticisms have been made and a preliminary indication of priorities have been obtained through rankings (Questionnaire Two), and participants have reviewed prior responses and have expressed their individual judgments as to the importance of each item (Questionnaire Three). Most importantly, the nature of a Delphi study lends itself to high support because the outcome, which can be identified as goals, objectives and programs, has been based on a consensus.

Status of Microcomputers in Schools

From a broad perspective, teachers have been encouraged to use computers as part of the classroom learning environment. On a nationwide level,

a recent survey (Reinhold, 1986) of the state departments of education clearly demonstrated that state-level support has been secured for computer use in schools. Trends indicated a willingness to hire more coordinators and to streamline methods for collecting information on local endeavors. With a minor exception, states overwhelmingly reported stronger local interest in computer education. Additionally, the National Governor's Association has formed a task force to study use and impact of educational technologies. The first report made strong recommendations for increasing funding and support for educational technology in the schools (Reinhold, 1986).

Reinhold (1986) reported that 1985-86 nationwide expenditures for hardware alone were $550 million. Software expenses reached $130 million dollars. About half of the states envisioned that more effort would be focused on looking for the best software to address their curriculum needs. The predominant focus of the survey indicated that there was a deeper commitment to use technology as a tool for learning.

This trend to encourage schools to use computers throughout the curriculum areas and grade levels has gained momentum for several years in purchasing more equipment. Becker (1985) investigated computer use variations and found that the number of computers in schools had quadrupled since 1983 to 1.023 million. At the same time, the number of computer-using students and teachers had tripled. Half of the secondary schools have over fifteen computers, while more than 7,500 elementary schools have more than fifteen.

Robbat (1986) has described some of the educational learning environments which are generally available to allow computers to be utilized for the purpose of instruction. The five types of settings were (1) a room with "stand alone" or networked computers for each student; (2) a classroom with a single computer; (3) a classroom with several computers; (4) a classroom with a large monitor used for teaching purposes; and (5) a school with computer centers.

Each environment has suggested different types of learning experiences on the part of students and different management issues for teachers and administrators. Several factors, however, argued for centralization of placement and authority over use of computers (Becker, 1983). Also, teachers indicated that centralization allowed entire classrooms or classroom groups to receive simultaneous instruction using the computer, leaving themselves free to handle other instruction for individual students or groups of students.

Teacher Uses of Microcomputers

According to the survey of school districts conducted by Ancarrow (1986), teachers' instructional use of computers was primarily for enrichment, followed by regular instruction in computer literacy and, finally, for remediation (drill and practice). Becker (1986) indicated that persons most knowledgeable and most active in the use of computers in schools were regular classroom teachers. The teacher's role was the critical factor for capitalizing on the instructional potential of microcomputers (VanDeusen and Donham, 1986-87). The impact of computers in educational settings has largely depended upon how teachers utilized them and how teachers viewed their effectiveness (Sutphin, 1987).

Teacher educators have been generally enthusiastic but cautious and concerned about widespread educational use of microcomputers in the absence of research and well-conceptualized theoretical models for implementation and use of the technology (Sutphin, 1987). Sutphin indicated that appropriate implementation of computer use in the public schools may very well be determined by the effectiveness of inservice programs. Illustrations which bring in related teaching and learning theories and concepts have been needed in inservice programs. The subject of how learning has taken place (metalearning), investigated by Novak and Gowin at Cornell University, could have direct application for use with computers (Sutphin, 1987). This line of research suggested the need for higher-order teaching/learning beyond the drill-and-practice level.

Studies have shown that teachers have not been trained well in the best uses of a limited number of computers (Scalfani, 1986). This lack of training in instructional methods that make computer use effective has been a serious problem. Since teachers do not know how to arrange the small-group activities and the learning-station approach, these methods have not been utilized. Instead, teachers have reverted to their standard practice: either the entire group of students was involved in a lecture-discussion format or everybody was doing worksheets waiting for their turns on the computer. Becker (1984) noted that more experienced teachers were better able to plan small-group activities.

Teacher Inservice Training Models

Teacher inservice training issues have been at the core of the computer

integration process (Lloyd, 1986). The Boston Public School District has incorporated a professional development model for computer education (Gardner, 1986). Focusing on that model, Gardner emphasized that a good curriculum should (a) provide a point of focus for computer instructors, (b) stipulate a coherent framework, and (c) outline a sequence of instruction that provides guidelines and direction. The Boston model was based on a structured series of courses and incentives to maximize teacher involvement. All personnel were offered a complimentary eighteen-hour introductory computer course that was available at regular intervals during the school year. Upon completion of this introductory course, personnel were then eligible to enroll in any of the forty-five, one- to three-credit university and in-service courses. These courses were taught in Boston school computer laboratories for varying fees. Eligibility for a series of professional-development grants was also an alternative to individual schools. If selected, a school could design an eighteen hour computer training program which would meet the particular staff's needs.

In Minnesota, the use of demonstration sites for teacher training in integrating technology into the curriculum has resulted in the development of IN-TECH (Randall, 1985). IN-TECH (Innovative In-Service for Integrating Technology in Classrooms) was a delivery system through which the use of computers and other technologies are used for retraining and developing staff members. This delivery system was being used in the labs of two school districts. A third site for IN-TECH was the use of a mobile lab, which visited school sites. The major objectives of IN-TECH were to train teachers as developers/ demonstrators of technology utilization and to build a network of school contact

persons. The inservice training provided through this program has emphasized the uses of technology in a myriad of subject areas including language arts, literature, mathematics, science, social studies, word processing, robotics, higher order skills and music.

To encompass the widely varying needs of teacher training across the nation, similar alternatives have been employed in a school district in Tennessee. In a cooperative spirit, two educational systems in Knox County, Tennessee investigated an innovative program to increase the quality of the integration process of computers in the curriculum (Templar, 1986). The success of an earlier cooperative computer project resulted in an allocation of funds to institute a pilot program revolving around three major users of computers: teachers, parents, and students. College classes were developed to train a small cadre of teachers within each elementary school. These teachers in turn worked on a peer level with their colleagues, helping to motivate and encourage others to work with computing skills. Additionally, these teachers developed programs for their classes that involved students in the process of learning with computers. The focus of the teacher training program included these five areas: (1) Logo and its application into the curriculum, (2) the use of computers as a tool, (3) reinforcement of basic skills through computer-assisted instruction, (4) utilizing available software to correlate reinforcement of basic skills in the existing general curriculum, and (5) computer literacy with emphasis on the use of the computer in today's society, and familiarization with computer history, vocabulary and equipment.

Computer Materials for the Elementary Classroom

The competitive retail market has been flooded with numerous guides for buying and understanding computers and a multitude of titles have covered the topics of computer literacy and various programming languages. Many quality books have been available to assist the educator who has been learning about educational computing. These have ranged from theoretical offerings such as MINDSTORMS (Papert, 1980), which supplied an explanation of the programming language Logo, to THE LAYMAN'S GUIDE TO THE USE OF COMPUTERS (Charp, 1982) which provided an overview from a computer-educator's perspective.

Most of the major publishers of school textbooks have upgraded their books to include computer references. However, few volumes have specifically and correctly addressed the K-8 teacher's primary concern, which has been particularly related to the classroom integration process. BUILDING COMPUTER AWARENESS (Mandell and Mandell, 1985) and COMPUTER TIME (Mandell and Mandell, 1986) have been useful to elementary teachers who have been including computer literacy studies. MY STUDENTS USE COMPUTERS (Hunter, 1983) offered detailed computer literacy activities that have focused on teaching students in the classroom to use computers for the same purposes that computers have been used in the "real" world. These activities include word processing, storing information in databases, problem solving, calculating, learning new concepts and simulating information for decision-making. Similarly, THE INSTRUCTORS BIG BOOK OF COMPUTER ACTIVITIES (Beckelman,

1984) was designed for the teacher who envisioned the computer as a tool with which to teach traditional content. Two activity books that have fostered the use of computers in the total curriculum are OFF AND RUNNING (Erickson, 1986) and INPUT (Junger, 1985). These guides have particularly focused on offline (not on the computer) computing activities for use in the elementary classroom.

In addition to text and activity books, a major portion of the elementary computing teacher's curriculum may be determined by the availability of quality software and how it has been integrated into specific learning situations. Since its conception several years ago, MICROZINE (Scholastic, 1983) has offered a scope and sequence to explain how activities could be integrated into the curriculum. Published at five different intervals each year, MICROZINE has employed the use of varying online computer activities to enhance student understanding and use of the computer as a tool. Other types of software are used in the classroom to benefit learning. For example, the nature of problem solving software lends itself to the enhancement of many types of thinking skills (Eiser, 1986). Additionally, due to its high quality and ease of use in teaching writing skills, FrEdWriter, a public domain word processing program has been used to enrich the teaching/writing/learning process in the elementary classroom (Williams, 1987). Numerous other software packages have been identified and recommended by elementary teachers as excellent resources to be previewed for possible classroom integration (Educational Software Preview Guide, 1987).

Microcomputer Use in Specific School Districts

Similar to thousands of other schools in the United States who are

struggling with he issue of how to implement computer education into the curriculum, the Eugene (Oregon) School District has instituted a computer integration plan (Turner, 1985). This program consisted of approximately 200 microcomputers spread across twenty-six elementary schools. Their philosophy stated that computers should be considered not as a separate subject but as a learning tool to support and be integrated into the regular curriculum. Specific guidelines referred to their integration process as being (1) implementable, (b) available, (c) inclusive, (d) expandable, (e) tangible, (f) transcendental (can surpass ordinary means of instruction), (g) foundational and (h) realistic. Computer curriculum components included graphics, keyboarding, word processing, problem solving, Logo and computer topics.

Hogue and Reagan (1985) emphasized a unique approach undertaken by the Lubbock Independent School District (LISD). The district, comprised of 16,000 students in K-6, houses thirty-eight elementary schools. The elementary schools, rather than the secondary, were selected for the development of a three-year plan of technology and implementation. The final phase of this program which culminated in the 1985-86 school year was developed to lay a foundation for problem-solving skills and computing in the elementary school-aged students. Implementation strategies involved use of computer labs in each elementary school, with two labs in the larger schools. Students worked a minimum of one period per week in the areas of computer assisted instruction/computer managed instruction, Logo programming, keyboarding, word processing and history/ computer ethics. Labs were directed by computer technologists who had

elementary classroom experience prior to the completion of 150 hours of staff development training in computer education.

In the Lincoln Public School system in Nebraska, an integrated curriculum, rather than a "band aid" approach, has provided the best possible path for the district to achieve its goal (Burnett and Friesen, 1986). Policy makers there have employed the philosophy that student learning would focus on utilizing appropriate skills and methodologies in developing computer-based solutions to real problems. For the integration process, all curricular areas made use of word processing and database software. Teachers recognized creative ways in which student productivity and problem-solving could be enhanced.

The Boston Public School system has offered yet another example of technology integration into education. The district consisted of approximately 60,000 students, 120 schools, and enjoyed a student ratio of one computer per nineteen students (Gardner, 1986). Curriculum emphasis was placed on the computer as a productivity tool. Additional curriculum concerns included an extensive use of commercially available software, a sound introduction to history, computer operation, and programming. Due to K-12 computer minimum competency standards in the Boston schools, two computer curriculums have been developed. One focuses on a core concepts and another focuses on elective concepts. Mandated minimum-competency curriculum for K-12 was the core curriculum while the elective curriculum could be enrichment programs and courses.

Minnesota has developed fifteen demonstration sites that reflect how technology was used in a wide variety of ways. "Since role models are such an

important part of teaching/learning theory, the demonstration sites are examples of theory put into practice" (Randall, 1986). Each demonstration site has developed its own objectives relative to the district goals. The Blue Earth Public School District in southern rural Minnesota was an example of one of the fifteen established demonstration sites. Project BEACON was undertaken to focus on plans for K-12 computer implementation program. Various technologies included microcomputers, printers, networked computer labs with hard disk drives, color video cameras, and a computer lab without networking capabilities. In addition, a demonstration large-screen TV, a voice input module, voice print equipment, modems, educational software, automated libraries and word processing software were utilized. The district objectives were to use technology to individualize learning in special education and general education, to improve writing and communication skills, and to create a comprehensive community resource file to make the human and material resources of the community more readily addressable and available to students, educators and the public.

Another example of a school system's implementation of technology was Knox County, Tennessee (Templar, 1986). This unique approach of cooperation between higher education and a public elementary education program resulted in the enrichment of both organizations. The Knox County School District was comprised of twenty-three elementary schools varying in size from rural schools with 150 to 200 students to suburban schools with 800 to 1000 students. Total attendance at these elementary schools was over 11,000. Logo applications, computer use as a tool, reinforcement of basic skills, software use and computer uses in today's society were emphasized.

Selected State Department Microcomputer Use Models

California took a leading role in the integration of computers in the curriculum (California State Department of Education, 1986). Technology in the Curriculum (TIC) products, which are K-12 products developed and provided to every public school in California, have helped teachers to more effectively achieve the learning objectives set forth by districts and the state. The philosophy of the State Department of Education has been that computer and video technologies offer exciting opportunities for furthering instructional goals in virtually all areas of the curriculum. By engaging the learner and increasing the learner's attentiveness to the content being delivered, technology can serve as a powerful instructional tool.

All of the TIC projects were designed to assist teachers who use technology to enhance and extend their existing curricula (California State Department of Education, 1986). Their primary goal has been to organize information about computers and video programs to serve as a tool for teaching content in English/ language arts, science, mathematics and history-social science. The projects identified portions of the curriculum that were best taught visually or electronically. High quality software and video programs available to teach that content were also a focus. Sample lesson plans have been designed so that teachers may incorporate as much of the material as they choose, while still relying on teaching methods with which they were comfortable and which were effective.

The Alaska State Department of Education has developed elementary and secondary computer education curriculum guides which have been organized around the topics of computer operation, computer application, problem solving, and computers in society (Alaska State Department of Education, August 1985). Intended to serve as a model to assist school districts as they developed and reviewed their own curriculum documents, these two curriculum guides were part of a series. The guides represented a synthesis of input from many sources. Each guide listed topics, concepts, learning outcomes, and sample learning objectives.

The elementary education curriculum guide for Alaska has been divided into three sections: Grades 1-3, 4-6, and 7-8. Topic/concepts described the major parts of the subject under consideration and they broadly defined the content that should be included in the study of each subject area. In general terms, learning outcomes described the expected student behaviors as a result of new learning experiences. Sample learning objectives were offered as indicators of student progress toward the stated goals.

The resource guide produced by the Hawaii State Department of Education (December 1984) consisted of several sections that were designed to coordinate teacher-developed materials in computer literacy. "Planning for Computer Instruction," the first section, provided an outline for developing a school level task force, management procedures for computer labs, and sample student survey forms. Sample activities for classroom use in the remaining sections, focused on major topics such as "Getting Started," "Logo," "word processing," and "BASIC." These sample activities included suggestions and guidelines for

teachers pertaining to appropriate grade levels, performance expectations, curriculum areas and prerequisites. The document also provided suggestions for materials, including hardware, software, and supporting peripherals, classroom management, teacher preparation, pre-computer activities, hands-on activities and follow-up enrichment activities. The materials reflected the teacher-developer's own environment. Variables included size of school, characteristics of student population, accessibility to microcomputers, and teaching style. Supporting materials included a computer literacy software list with notations of grade level, price and publisher, recommended periodicals for teachers, computer books for students, teacher references, and local resources on computer education.

Summary

The review of the literature focused upon educational uses of the Delphi technique as a problem solving process to build a consensus of opinion. While the Delphi technique was originally developed for the purpose of future forecasting, it has been used in modified forms in educational settings which focus on what participants would like to see happen, rather than on what is likely to happen (Hartman, 1981). The literature also identified studies, projects and activities that reflected the impact of educational computing in elementary schools. Many state departments of education have taken a leading role in the development of educational computing guidelines and planning models. School districts have been active in planning in-services for classroom teachers. Teacher inservice training issues have been at the core of the computer

integration process (Lloyd, 1986). Much diversity has existed in the ways in which computing instruction has been delivered. In the computing classroom, quality software, textbooks and other teaching materials have become available to assist with the integration of computers in the curriculum. Most of the major publishers of textbooks have upgraded their books to include computer references, but few volumes have specifically addressed the K-8 teacher's primary concern, which has been related to the classroom integration process. Computers have been used in laboratory settings in schools, yet no clear direction has been established for building a computer integration model for laboratory computing teachers in the elementary schools. Curriculum inconsistencies concerning (a) the identification of appropriate computing content areas for elementary students and (b) instructional topics and activities that support each computing content area. Finally, no computing model has been identified that can be used by laboratory computing teachers to integrate computing instruction topics and activities across the traditional elementary school curriculum.

CHAPTER III

METHODS AND PROCEDURE

Population and Sample

Educators identified as experts in the field of elementary educational computing represented the population for this study. These experts (a) possessed three to five years of teaching and/or training experience in educational computing at the elementary level and (b) were presently involved in teaching and/or training teachers in the field of elementary computing. For the sample, fourteen experts were chosen to be representative of major geographical cross-sections of the country. Approximately half of the experts were educators who had accrued experience as a teacher in the elementary grades and had been involved with using computers in an educational setting such as a classroom. In addition, they had also displayed, through publications or consultant work, national leadership potential in the area of educational computing. The other half of the experts for this study were teacher educators who had obtained field experience in elementary education and had actively participated in training elementary teachers in classroom use of computers.

The availability of educational experts who qualified for participation in this study was a prime consideration in selecting the sample. A list of potential participants was developed by the investigator. From this initial list, possible

respondents were contacted by phone to determine interest in this study, motivation to be personally involved in the development of a computer integration model, and finally, to determine if a time commitment could be made relative to their participation in the study.

Procedure of the Study

The Delphi technique was used to develop a computer integration model for elementary laboratory computing teachers. The Delphi technique is a group process which establishes a consensus by employing a series of three or more rounds of correspondence with the subjects. A sample of fourteen experts were initially identified for this study. Six of the experts were elementary laboratory computing teachers and eight were teacher educators.

According to Delbecq, Van De Van, & Gustafson (1975), ten to fifteen experts are needed to conduct a valid Delphi study. Prior to the completion of Questionnaire Two, three experts, all laboratory computing teachers, withdrew their participation. One of the experts was unable to commit the time necessary to participate in all phases of the study. The other two teachers expressed that major philosophical differences with the development of this model prevented them from further involvement. The major difference was related to their bias against the development of a computer integration model specifically to be used by laboratory computing teachers. Eleven sets of responses collected from three rounds of correspondence were used in the final analyses of the study. The investigation was conducted over a period of four months, September 1987, through January 1988.

A modification of the original Delphi technique designed for future forecasting was implemented in this study.

For information-gathering purposes, three separate instruments were designed as questionnaires for this investigation. Based upon the literature reviewed, the investigator identified eight major instructional computing content areas that were considered appropriate for the elementary computing curriculum. With substantiated criteria for a computing integration model identified, experts' responses were elicited to (a) more acutely define the computing content areas that could be used to support computing instruction in elementary schools; (b) develop instructional topics within each computing content area that best supported instruction in that content area; and (c) identify activities in which laboratory computing teachers could integrate the computing content areas into the traditional elementary curriculum subjects of language arts, mathematics, science and social studies. The following is a detailed explanation of the instruments and of the techniques utilized to accumulate information for the computer curriculum model for elementary schools.

Correspondences for the Modified Delphi Approach

Correspondence Number One.

The information contained in the first contact with the experts consisted of (1) a cover letter of introduction, (2) instructions for responding to the Delphi Questionnaire One, and (3) Questionnaire One (Appendix A). These were distributed through the mail on September 18, 1987, to the fourteen computing

experts who had been identified as sample subjects. The experts were allotted three weeks to complete the questionnaire and were asked to return the form by October 12, 1987.

Questionnaire One contained two components. Part One asked the respondents to (a) think about the role of the full-time elementary computing teacher and/or the teacher educator/in-service trainer and then (b) review each of the eight computing content areas that had been identified through the literature and indicate their agreement or disagreement with the accuracy of these computing content areas for elementary grades (K-8). The experts were instructed to transfer any changes in the computing content areas from Part One to the appropriate area in Part Two. Part Two consisted of eight forms. Each form contained three columns entitled "Computing Content Area", "Topic", and "Curriculum Integration Activities". In the second column, experts were asked to record at least two computing topics that they believed were appropriate for each computing content area. If topics were not unique to one content area, subjects were encouraged to list topics in more than one computing content area. In the third column, experts were instructed to list at least two examples of activities/ techniques appropriate for each topic that could be used across the elementary curriculum. The investigator supplied a sample topic with two corresponding activities to provide further clarification. Experts were given three weeks to reply to Questionnaire One. Those who failed to return the instrument in the allotted time were contacted through follow-up phone calls. Response time for this first correspondence was slower than anticipated and six weeks elapsed before all questionnaires were returned.

Correspondence Number Two.

The second correspondence was comprised of (1) a cover letter which contained instructions for subject response and (2) Questionnaire Two (Appendix B). These were distributed through the mail on November 12, 1987, to fourteen experts who were instructed to return the questionnaire by November 25, 1987.

An analysis of Questionnaire One resulted in a summary that formed the foundation of Questionnaire Two. Because it was important that each item in Questionnaire Two accurately conveyed the meaning which respondents communicated in Questionnaire One, compiling and assimilating the responses was a lengthy process. Furthermore, the legitimacy of a Delphi study depends upon each questionnaire being ready and sent to participants on time. Because response time to Questionnaire One was longer than anticipated, the investigator felt the need to make an immediate analysis and send Questionnaire Two as quickly as possible. One participant did not return Questionnaire One and asked to withdraw from the study due to personal time constraints.

This analysis of Questionnaire One was completed in three steps. During step one, questionnaires from the thirteen experts were used by the investigator to compile a list of responses for each column, computing content area (column one), topic (column two) and curriculum integration activities (column 3). Comments that elaborated on any item were also noted. During step two, this compilation of responses was reviewed and analyzed. Areas of agreement and disagreement were identified and items requiring clarification were discussed with several colleagues. Finally, in step three, a listing of the combined topics

and also the combined curriculum integration activities was prepared from the second step of analysis.

Based on the consensus of experts' responses, the eight original computing content areas were combined as follows:

(1) Applications/Tools

(2) Computer Operations/Keyboarding

(3) Computers and Their Role in a Technological Society

(4) Problem Solving

(5) Programming

For each computing content area, a list of the compiled topics were placed in alphabetical order to form PART A of Questionnaire Two. Similarly, for each topic under each computing content area, a list of the compiled curriculum integration activities was placed in a logical order that corresponded to the computing topics to form PART B of Questionnaire Two.

In Questionnaire Two, experts were asked to appropriately rate each factor (topic or activity) on a one to five point continuum, according to how the factor supported the instruction for the computing content area or for the computing topic. In PART A, experts rated topics for each of the content areas by indicating a rating of 1 for "Low Support" and 5 for "High Support" (Figure 1). PART B consisted of an identical rating scheme, however, experts rated curriculum integration activities in relation to how the activities supported each of the computing topics (Figure 2). For purposes of clarification, the two components of Questionnaire Two were color-coded. PART A, a composite of topics supporting each computing content area, was a white document. PART B, a composite of

curriculum integration activities supporting the individual topics in each computing content area, was a multi-colored document.

PART A

APPLICATIONS/TOOLS

Below are the combined topics that were suggested for this content area. In order for a priority to be determined, please rank each topic (on a five point continuum) based on how you feel the topic supports the specific content area. Indicate your response by marking the desired blank for each topic, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Databases	___	___	___	___	___
Electronic Spreadsheets	___	___	___	___	___
Graph/Animation/Chart/Printing/ Survey Tool Utility/Packages	___	___	___	___	___
Programming	___	___	___	___	___
Telecommunications	___	___	___	___	___
Peripheral Tools	___	___	___	___	___
Word Processing	___	___	___	___	___

Figure 1. Ratings of Applications/Tools Topics

PART B

APPLICATIONS/TOOLS

1. Databases

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Mapping skills	___	___	___	___	___
Politics unit	___	___	___	___	___
Study Presidential bibliographies	___	___	___	___	___
Global geographical study and classification of countries	___	___	___	___	___
Research of the states	___	___	___	___	___
Animal classifications unit	___	___	___	___	___
Preparing student polls	___	___	___	___	___
Categorize book reviews, reports	___	___	___	___	___
Record weather information	___	___	___	___	___
Develop student identification list	___	___	___	___	___
Gather, sort and process information for projects and reports	___	___	___	___	___
Planetary studies	___	___	___	___	___
Study of dinosaurs	___	___	___	___	___
Study of community/state	___	___	___	___	___
Rocks/minerals classifications unit	___	___	___	___	___

Figure 2. Ratings of Applications/Tools Curriculum Integration Activities

The experts were given two weeks to complete and return Questionnaire Two. Follow-up phone calls were made to contact those who failed to reply in the allotted time. Response time for the second correspondence was also slower than anticipated and four weeks elapsed before all questionnaires were returned. Two experts returned Questionnaire Two and asked to withdraw from the study.

As classroom elementary teachers, they felt their responses were inappropriate for building experiences for an elementary laboratory computing teacher.

Correspondence Number Three.

Questionnaire Three (Appendix C) represented the final phase of the modified Delphi study and was designed to determine a consensus of ranking order by the experts for the computing topics and integration activities for each computing content area. This questionnaire consisted of a cover letter with instructions for expert responses and Questionnaire Three. Consistent with the two previous correspondences, Questionnaire Three, dated December 18, 1987, was distributed through the mail. The eleven experts were asked to return the questionnaire by December 30, 1987.

An analysis of Questionnaire Two resulted in the development of this third document. The investigator analyzed Questionnaire Two by tallying the subjects' responses of the combined topics (Part A) and the combined curriculum integration activities (Part B). The investigator compiled responses using a blank form of Questionnaire Two as a tally sheet. This sheet displayed the total support rating received by each topic in Part A and the total support rating for each curriculum integration activity in Part B. The ratings were displayed in a manner that permitted the investigator to view the responses made by all experts and examine the diversity of the ratings assigned to each item. The total rating for a topic or curriculum integration activity was obtained by adding the individual ratings of the eleven experts. A group average support rating was calculated for each computing topic and each curriculum integration activity.

Using the individual group averages, the computing topics and the curriculum integration activities for each computing content area from this questionnaire were ranked and then placed in rank order to form PART A and PART B of Questionnaire Three. Questionnaire Three was also divided into two components, Part A and Part B. Part A (Figure 3) contained a ranked listing of the topics that reflected the experts' evaluation of how well the topics supported the specific computing content area. Part B (Figure 4) contained a ranked listing of the curriculum integration activities that reflected the experts' evaluation of how well the integration activities supported the computing topics within each computing content area.

Rank No.	Topic	Group Average
1.	Word Processing	5.00
2.	Databases	4.91
3.5	Telecommunications	4.27
3.5	Graph/Animation/Chart/Printing/ Survey Tool/Utility Packages	4.27
5.	Electronic Spreadsheets	4.09
6.	Peripheral Tools	3.36
7.	Programming	2.65

Figure 3. Ranks and Group Averages of Applications/Tools Topics

Rank No.	Topic	Group Average
1.5	Keep records for school club and/or make-believe business	4.45
1.5	Unit on problem solving with estimation/ calculation skills	4.45
3.5	Study of math formulas/story problems	3.73
3.5	Study of banking and currency	3.73
6.	Unit on decimals and percents	3.55
7.	Financial or numeric data collection	3.36

Figure 4. Ranks and Group Averages of Applications/Tools Curriculum Integration Activities

Group averages calculated from experts' responses from Questionnaire Two were included for clarification of the rankings listed. In this questionnaire, experts were asked to examine the rankings of the topics and curriculum integration activities and to indicate which ones (if any) should be ranked significantly higher or lower. Experts were reminded that the topics and activities were originally rated on a five point continuum ranging from Low Support (1) to High Support (5) and that the activities with the highest group averages provided the strongest support for the specific topic or activity. The experts were encouraged to make comments for further explanation of ranking changes.

For purposes of clarification, Parts A and B were color-coded to be consistent with the procedure followed in Questionnaire Two. Part A, the ranked listing of topics, was a white document while Part B, the ranked listing of computer integration activities, was a multi-colored document. The subjects were allotted two weeks to complete and return this questionnaire. Follow-up phone

hundred percent (11) of the questionnaires were returned. Response time for this third correspondence was four weeks.

Duplication of Responses.

The responses gathered from Questionnaire One and listed on Questionnaire Two contained some areas of duplication. For example, some experts listed a specific topic in more than one computing content area. Duplication of this nature was not eliminated. The investigator believed that, due to the variability in the experts' experiences, some factors were likely to appear in more than one category.

Summary

A modified Delphi technique using three rounds of correspondence with a set of eleven experts was used to develop a computer integration model for laboratory computing teachers in elementary schools. A modified version of this technique was used to accommodate the focus of this investigation. Questionnaire One presented the computing content areas that had been identified from the literature and asked experts to refine the list. Experts were then asked to identify topics of instruction for each computing content area. With these topics established, experts were asked to list at least two examples of curriculum integration activities that could be used to support the instruction of each topic area and related directly to the traditional elementary curriculum subjects of language arts, mathematics, science and social studies.

Questionnaire Two was developed from the compilation of the experts' responses from Questionnaire One. Part A listed a composite of topics that were identified for computing content area. Part B listed composite of curriculum integration activities that were identified for the individual topics in each computing content area. Experts were asked to rate each topic or integration activity on a one to five point continuum, according to how it supported the instruction for the computing content area or computing topic.

Questionnaire Three was designed to draw closure to the Delphi study and was developed through an analysis of Questionnaire Two. Using group average ratings determined from Questionnaire Two, Part A consisted of a ranked listing of computing topics that supported each identified computing content area. Part B consisted of a ranked listing of curriculum integration activities that supported the individual topics in each computing content area. The experts were asked to examine the rankings and make appropriate changes that indicated the computing topics or integration activities that should be ranked significantly higher or lower.

The experts' responses from Questionnaire Three were examined and analyzed to formulate the final computer integration model generated as a product from this study (Appendix D). Ranking changes were compiled for clarification and use of this computer integration model.

CHAPTER IV

ANALYSIS AND PRESENTATION OF DATA

Introduction

The purpose of this study was to use the Delphi consensus technique with recognized educational computing experts to develop an elementary computing integration model for laboratory computing teachers. This model was created for utilization in grades K-8 to assist with the integration of computer education across the total curriculum.

This study was conducted with the experts using a set of three correspondences entitled Questionnaire One, Two, and Three. Questionnaire One asked the experts to (a) refine the list of computing content areas that supported computing instruction in the elementary schools, (b) develop instructional topics within each computing content area that best supported instruction in that content area, and (c) identify curriculum integration activities that related to the instructional topics within each computing content area. Correspondence Two asked the experts to rank the topics and activities on a one to five point continuum, based upon how the topics and activities supported the curriculum. Finally, Questionnaire Three asked the experts to examine the rankings of the topics and activities and indicate if these should be ranked

significantly higher or lower. Experts were also asked to provide comments that further reflected their opinion.

After Questionnaire One was analyzed, the computing content areas were reduced from eight areas to five. These were (1) Applications/Tools, (2) Computer Operations/Keyboarding, (3) Computers and Their Role in a Technological Society, (4) Problem Solving, and (5) Programming. In addition, the experts generated six or seven topics for each computing content area and approximately five to fifteen curriculum integration activities for each topic.

Through the analysis of Questionnaire Two, a group average was calculated to determine the experts' indication of how well the topic supported the computing content area and how well the curriculum integration activities supported the individual topics. According to the group averages, these topics and activities were placed in ranked order to indicate their support in the teaching of the content area.

Based on the analysis of Questionnaire Three, the investigator determined the consensus among the experts regarding ranking order of the topics and curriculum integration activities that best supported each computing content area. The remainder of this chapter discusses the consensus of the experts concerning the overall rankings of topics and curriculum integration activities that were compiled from Questionnaire Three. This discussion is divided into two parts corresponding to Part A and Part B of the questionnaire.

Part A – Topics for Computing Content Areas

Part A consisted of topics that related to the five computing content areas

that were refined by the experts. These topics were (1) Applications/Tools, (2) Computer Operations/Keyboarding, (3) Computers and Their Role in a Technological Society, (4) Problem Solving, and (5) Programming. The experts suggested seven major topics of instruction within Applications/Tools, Computer Operations/Keyboarding and Computers and Their Role in a Technological Society. Six instructional topics were developed for the areas of Problem Solving and Programming. Rankings and group averages for the topics in each of these five computing content areas were reported in Tables I-V.

All eleven of the experts agreed with the rankings of topics for the content area of Applications/Tools. This is the only computing content area that received one hundred percent agreement within the topics.

Nine of the eleven experts indicated agreement for the areas of Computers and Their Role in a Technological Society and Problem Solving. One expert expressed disagreement with a ranked topic within the area of Computers and Their Role in a Technological Society and made a comment that "the ethics underlying Copyright Laws/Computer Crime/Privacy, ranked number two on the scale, are a strong strand to teach across all content areas and deals not only with legal issues but also with personal responsibility and respect for others." Another expert changed the ranking of "Equity in Computer Issues" from three to five, but provided no explanation for the change. For the area of Problem Solving, two of the experts indicated that the topic "Brainstorming" should be ranked higher. One expert justified the ranking change with this comment: "In a hierarchy of thinking skills or cognitive development, brainstorming is a prerequisite to hypotheses development. Group cooperation skills should be

developed as soon as possible for best transference to regular classroom activities."

For the computing content area of Programming, eight experts indicated that the rankings were appropriate for the topics. No consistent reason for ranking changes could be determined from an analysis of the three experts who disagreed with the rankings.

Seven of the eleven experts agreed with the rankings of topics for Computer Operations/Keyboarding. One expert commented that "knowledge and use of correct vocabulary is a basic factor for this content area" and indicated that the ranking should be higher.

TABLE I

RANKS AND GROUP AVERAGES OF APPLICATIONS/TOOLS TOPICS

Rank No.	Topic	Group Average
1.	Word Processing	5.00
2.	Databases	4.91
3.5	Telecommunications	4.27
3.5	Graph/Animation/Chart/Printing/ Survey Tool/Utility Packages	4.27
5.	Electronic Spreadsheets	4.09
6.	Peripheral Tools	3.36
7.	Programming	2.65

TABLE II

RANKS AND GROUP AVERAGES OF COMPUTER OPERATIONS/KEYBOARDING TOPICS

Rank No.	Topic	Group Average
1.	Proper Keyboarding	4.73
2.	Disk Handling	4.55
3.	Develop Speed and Accuracy	4.09
4.5	System Components (Hardware)	3.91
4.5	Vocabulary Development	3.91
6.	Operating System Commands	3.64
7.	Use of Software Documentation	3.45

TABLE III

RANKS AND GROUP AVERAGES OF COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY TOPICS

Rank No.	Topic	Group Average
1.	Communications/Telecommunications	4.64
2.	Copyright Laws/Computer Crime/Privacy	4.45
3.	Computers in the Workplace	4.36
4.	Computer in Our Future	4.27
5.	Equity in Computer Usage	3.82
6.	Computers and the Handicapped	3.73
7.	History of Technology	2.91

TABLE IV

RANKS AND GROUP AVERAGES OF PROBLEM SOLVING TOPICS

Rank No.	Topic	Group Average
1.	Hypotheses Development/Alternate Solutions	5.00
2.5	Group Cooperation Skills	4.91
2.5	Computer Applications as Tools for Solving Problems (i.e. databases/spreadsheets)	4.91
4.	Problem Solving Software	4.64
5.	Brainstorming	4.36
6.	Programming	2.73

TABLE V

RANKS AND GROUP AVERAGES OF PROGRAMMING TOPICS

Rank No.	Topic	Group Average
1.	Languages (BASIC, Logo)	4.27
2.	Programming of Speech Synthesizers, Robots and Other Peripherals	3.91
3.	Program Documentation/Error Tracking/Editing	3.73
4.	Using Algorithms for Solving Problems	3.45
5.5	Top Down Programming	3.36
5.5	Programming Tutorials/Problem Solving Software	3.36

Part B – Curriculum Integration Activities

Part B consisted of curriculum integration activities that related to the topics suggested by the experts. Several experts expressed concern in being able to

appropriately rank the activities due to the variations of types of activities used from grade to grade. As one expert expressed, with specific relation to database use: "These priorities really depend on the grade level. For example, primary grades would rank dinosaurs and animals higher. Middle grades would rank states and geography at a higher priority."

Applications/Tools. Under the computing content area of Applications/ Tools, the experts suggested seven areas for curriculum integration activities. These were: (1) Databases, (2) Electronic Spreadsheets, (3) Graph/Animation/ Chart/Printing/Survey Tool/Utility Packages, (4) Programming, (5) Telecommunications, (6) Peripheral Tools, and (7) Word Processing. Tables VI through XII report the individual activities with their rankings and group averages.

All of the eleven experts agreed with the rankings for two areas, Electronic Spreadsheets and Programming activities. Relative to the use of spreadsheets, an expert noted: "This is not an exhaustive list. Many applications are possible."

Ten of the eleven experts agreed with the ranking of activities in the area of Graph/Animation/Chart/Printing/Survey Tool/Utility Packages.

Nine of the eleven experts agreed with the rankings of curriculum integration activities within the two areas of Databases and Peripheral Tools.

Seven of the eleven experts agreed with the integration activity rankings for Telecommunications and Word Processing. In this category, of the four who expressed disagreement with the rankings, two experts indicated that electronic

mail communications should be ranked number one and two experts suggested that keyboarding activities should be ranked number one.

TABLE VI

RANKS AND GROUP AVERAGES OF "ELECTRONIC SPREADSHEET" ACTIVITIES IN APPLICATIONS/ TOOLS CONTENT AREA

Rank No.	Topic	Group Average
1.5	Keep records for school club and/or make-believe business	4.45
1.5	Unit on problem solving with estimation/ calculation skills	4.45
3.5	Study of math formulas/story problems	3.73
3.5	Study of banking and currency	3.73
6.	Unit on decimals and percents	3.55
7.	Financial or numeric data collection	3.36

TABLE VII

RANKS AND GROUP AVERAGES OF "GRAPH/ANIMATION/CHART PRINTING/SURVEY TOOL/UTILITY PACKAGES" ACTIVITIES IN APPLICATIONS/TOOLS CONTENT AREA

Rank No.	Topic	Group Average
1.5	Development of timeline activities	4.64
1.5	Chart the population of countries	4.64
3.5	Illustration of reports and projects	4.55
3.5	Teach scientific observation/measurement and hypothesis	4.55
5.5	Graph calendar and/or weather information	4.27
5.5	Make math (or other content area) slide show with graphs	4.27
7.	Use with traditional art activities	4.09
8.	Chart distribution of different colors M&M's in a package	3.91
9.5	Animation activities	3.64
9.5	Create signs and advertisements	3.64
11.5	Plot modes of transportation to school	3.45
11.5	Calculate distribution of parents' occupations	3.45
13.	Chart the number of manned space flights per year	2.82
14.	Language analysis using parts of speech	2.64

TABLE VIII

RANKS AND GROUP AVERAGES OF "PROGRAMMING" ACTIVITIES IN APPLICATIONS/TOOLS CONTENT AREA

Rank No.	Topic	Group Average
1.	Use LogoWriter to develop illustrate language story	4.73
2.	Study algorithms of simple mathematics formulas	3.55
3.	Create math story problems	3.27
4.	Vocabulary unit on programming concepts/ fundamentals	3.00

TABLE IX

RANKS AND GROUP AVERAGES OF "DATABASE" ACTIVITIES IN APPLICATIONS/TOOLS CONTENT AREA

Rank No.	Topic	Group Average
1.	Study of community/state	4.82
3.	Global geographical study and classification of countries	4.73
3.	Gather, sort and process information for projects and reports	4.73
3.	Study of dinosaurs	4.73
7.	Animal classifications unit	4.64
7.	Preparing student polls	4.64
7.	Record weather information	4.64
7.	Planetary studies	4.64
7.	Rocks/minerals classifications unit	4.64
10.	Research of the states	4.55
11.	Develop student identification list	4.36
12.	Categorize book reviews, reports	4.09
13.	Study Presidential bibliographies	3.91
14.	Politics unit	3.82
15.	Mapping skills	3.00

TABLE X

RANKS AND GROUP AVERAGES OF "PERIPHERAL TOOLS" ACTIVITIES IN APPLICATIONS/TOOLS CONTENT AREA

Rank No.	Topic	Group Average
1.	Use touch window technologies in any content area	3.55
2.	Use joystick/mouse devices with and simulation activities	3.45
3.5	Use self-contained keyboard synthesizers	3.36
3.5	Use graphics tablets to make pictures and signs	3.36
5.	Communicate conversations through synthesizers interfaced with micros	2.73

TABLE XI

RANKS AND GROUP AVERAGES OF "WORD PROCESSING" ACTIVITIES IN APPLICATIONS/TOOLS CONTENT AREA

Rank No.	Topic	Group Average
2.	Writing process unit (concepts)	4.82
2.	Creative writing activity	4.82
2.	Journalism/newspaper unit	4.82
5.	Classroom newsletter	4.64
5.	Write research reports	4.64
5.	Poetry unit	4.64
7.	Keyboarding practice activities (dialog, math story problems)	3.64
8.	Parts of speech unit	2.82

TABLE XII

RANKS AND GROUP AVERAGES OF "TELECOMMUNICATIONS" ACTIVITIES IN APPLICATIONS/TOOLS CONTENT AREA

Rank No.	Topic	Group Average
1.	Compare cultures with pen pals	4.73
2.	Develop research/library skills	4.36
3.	Electronic mail communications	4.27
4.	Create journal/diary	3.91

Computer Operations/Keyboarding. Seven areas of curriculum integration activities were developed for the area of Computer Operations/Keyboarding. These were: (1) Develop Speed and Accuracy, (2) Disk Handling, (3) Operating System Commands, (4) Proper Keyboarding, (5) Systems Components

(Hardware), (6) Vocabulary Development, and (7) Use of Software Documentation. Tables XIII through XIX report the individual activities with their rankings and group averages.

A high degree of consensus in ranking order existed among the exports in the area of integration activities for Computer Operations/Keyboarding. All eleven experts agreed upon ranking order for six of the seven activity areas. The only area with slight disagreement in the rankings was Proper Keyboarding, in which ten of the eleven experts agreed with the rankings.

TABLE XIII

RANKS AND GROUP AVERAGES OF "DEVELOP SPEED AND ACCURACY" ACTIVITIES IN COMPUTER OPERATIONS/ KEYBOARDING CONTENT AREA

Rank No.	Topic	Group Average
1.	Use typing tutorials/software	4.82
2.	Typing practice exercises	4.73
3.	Focus a lesson on occupations that require employees to consistently use keyboarding skills	3.27
4.	Invite school secretary to speak about keyboarding and importance of computers in the office	3.18

TABLE XIV

RANKS AND GROUP AVERAGES OF "DISK HANDLING" ACTIVITIES IN COMPUTER OPERATIONS/ KEYBOARDING CONTENT AREAS

Rank No.	Topic	Group Average
1.	Lesson on appropriate use of software	4.45
2.	Diskette preparation for information storage	4.36
3.	Dissect a disk to demonstrate its parts	4.18
4.5	Unit on magnetics and the impact on diskettes	3.18
4.5	Study how information is placed on diskette	3.18
6.	Write letters to a diskette manufacturer to get information and trends about diskette use	3.09

TABLE XV

RANKS AND GROUP AVERAGES OF "OPERATING SYSTEM COMMANDS" ACTIVITIES IN COMPUTER OPERATIONS/ KEYBOARDING CONTENT AREAS

Rank No.	Topic	Group Average
1.	Conduct computer work session (save, load, delete from disk)	4.64
2.	Practice copying a public domain disk	4.18
3.	Read/discuss children's book on computer operations	3.55
4.	Program debugging activities	2.55

TABLE XVI

RANKS AND GROUP AVERAGES OF "PROPER KEYBOARDING" ACTIVITIES IN COMPUTER OPERATIONS/KEYBOARDING CONTENT AREA

Rank No.	Topic	Group Average
1.	Unit on keyboarding	4.82
2.5	Revision process lessons	4.55
2.5	Skill development toward the development of writing skills	4.55
4.	Use copy of a practice keyboard	4.09
5.	Use language development software	3.55
6.	Discuss topic poster	3.09
7.	Spelling, reading or handwriting lesson	3.00
8.	P.E. activities that develop good body positioning	2.91
9.	Use regular handwriting lesson to develop finger strength	2.82

TABLE XVII

RANKS AND GROUP AVERAGES OF "SYSTEMS COMPONENTS (HARDWARE)" ACTIVITIES IN COMPUTER OPERATIONS/ KEYBOARDING CONTENT AREA

Rank No.	Topic	Group Average
1.	Identification/care of components	4.45
2.	Simulation activities illustrating input/ process/output	3.36
3.	Reading/spelling activities	2.82
4.	Study computer mathematical functions	1.73

TABLE XVIII

RANKS AND GROUP AVERAGES OF "VOCABULARY DEVELOPMENT" ACTIVITIES IN COMPUTER OPERATIONS/ KEYBOARDING CONTENT AREA

Rank No.	Topic	Group Average
1.	Student-generated glossary/pictionary	4.64
2.	Science technology unit	
3.	Activity focusing on contextual use of words	4.09
4.5	Match word with definition	4.00
4.5	Use game-type formats to develop skills	4.00
6.	Crossword puzzle	3.73
7.	Spelling unit	3.55

TABLE XIX

RANKS AND GROUP AVERAGES OF "USE OF SOFTWARE DOCUMENTATION" ACTIVITIES IN COMPUTER OPERATIONS/KEYBOARDING CONTENT AREA

Rank No.	Topic	Group Average
1.	Lesson on following directions	4.45
2.5	Reference skills	4.09
2.5	Reading comprehension skills	4.09

Computers and Their Role in a Technological Society. Under this computing content area, the experts suggested seven areas for curriculum integration activities. These were: (1) Communication/Telecommunications, (2) Computers and the Handicapped, (3) Computers in the Workplace, (4)

Computers in Our Future, (5) Copyright Laws/Computer Crime/Privacy, (6) Equity in Computer Usage, and (7) History of Technology. Tables XX through XXVI report the individual activities with their rankings and group averages.

Three of the activities areas, Communications/Telecommunications, Computers in the Workplace, and Equity in Computer Usage, received total agreement in the ranking order by all eleven of the experts. Ten of eleven experts agreed with the ranking order in four areas of the curriculum integration activities. These activity areas were: (1) Computers and the Handicapped, (2) Computers in Our Future, (3) Copyright Laws/Computer Crime/Privacy and (4) History of Technology. The one expert who disagreed in this category ranked number five higher, and commented: "A discussion of related articles, books and movies has more relevance on student life than a community helpers unit or a health unit on the handicapped."

TABLE XX

RANKS AND GROUP AVERAGES OF "COMMUNICATIONS/ TELECOMMUNICATIONS" ACTIVITIES IN COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY CONTENT AREA

Rank No.	Topic	Group Average
1.	Modem and cable TV use	4.18
2.	Develop class story books	4.00
3.	Create a student newspaper	3.91
4.	Use of computerized card catalog in a library	3.64
5.	Biography writing unit on famous people	3.45
6.	Science fiction story writing	3.18
7.	Study the history of the American expansion	3.09

TABLE XXI

RANKS AND GROUP AVERAGES OF "COMPUTERS AND THE HANDICAPPED" ACTIVITIES IN COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY CONTENT AREA

Rank No.	Topic	Group Average
1.	Watch a videotape illustrating new technologies	4.27
2.	Invite guest speaker to classroom	4.18
3.	Study of community helpers	3.73
4.	Health unit on special needs of the handicapped	3.55
5.	Discuss related articles, books, movies	3.45

TABLE XXII

RANKS AND GROUP AVERAGES OF "COMPUTER IN THE WORKPLACE" ACTIVITIES IN COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY CONTENT AREA

Rank No.	Topic	Group Average
1.	Study of technology uses in the community	4.73
2.	Interview speaker from technology professionals	3.91
3.5	Write a report on computer careers	3.73
3.5	Banking unit	3.73
5.	Unit on transportation	3.55
6.5	Inventions/inventors unit	3.45
6.5	Discuss calculators and "manual vs. mechanical" issues	3.45
8.	Computers in the entertainment industry	3.36
9.5	Password game to identify occupations	3.18
9.5	Design and print pictures of computer use in business	3.18
11.	Match job titles with descriptions	2.91
12.5	Compare various computer companies by size, structure and products	2.18
12.5	Unit on forecasting financial situations	2.18

TABLE XXIII

RANKS AND GROUP AVERAGES OF "COMPUTERS IN OUR FUTURE" ACTIVITIES IN COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY CONTENT AREA

Rank No.	Topic	Group Average
1.	Read stories and brainstorm	4.64
2.	Unit on the "house of the future"	4.36
3.	Unit on robotics	4.27
4.	Studies on space travel and astronomy	4.18
5.	Science fiction unit	4.09
6.	Use graphics software to design the structure of a house of the future	3.91
7.	Artificial intelligence unit	3.73

TABLE XXIV

RANKS AND GROUP AVERAGES OF "COPYRIGHT LAWS/ COMPUTER CRIME/PRIVACY" ACTIVITIES IN COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY CONTENT AREA

Rank No.	Topic	Group Average
1.	Discussion of copyright laws as related to all content areas	4.55
2.	Role play classroom lesson on illegal copying of software	3.64
3.	Legal/social implications on use of large databases (i.e. social security/drivers license bureau)	3.55
4.	Discuss use of modems for data transfer	3.36
5.5	Write essay about misuse of computer data	3.27
5.5	Communications/journalism unit	3.27
7.	Values clarification activity	3.18
8.	Unit on U.S./local government	2.91
9.	Unit on criminal justice system	2.36

TABLE XXV

RANKS AND GROUP AVERAGES OF "EQUITY IN COMPUTER USAGE" ACTIVITIES IN COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY CONTENT AREA

Rank No.	Topic	Group Average
1.	Survey of student usage of computers in the school	4.45
2.	Survey of student preferences in software	4.27
3.	Compare and contrast cultural differences	3.36
4.5	Study effects of employment	3.09
4.5	Study of women and/or minorities in the workplace	3.09

TABLE XXVI

RANKS AND GROUP AVERAGES OF "HISTORY OF TECHNOLOGY" ACTIVITIES IN COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY CONTENT AREA

Rank No.	Topic	Group Average
1.	Develop a timeline or wall chart of the generations of computers	4.18
2.	Invite a guest speaker from the community	3.91
3.	Compare trends in computing to agricultural and industrial development	3.45
4.	Create database using informations on the generations of computers	3.27
5.5	Unit on mainframes, minis, micros	2.91
5.5	Biographical studies of key people in the development of technology	2.91

Problem Solving. The experts suggested six areas of curriculum integration activities for the topic of Problem Solving. The six areas were: (1) Brainstorming, (2) Computer Applications as Tools for Solving Problems, (3) Group Cooperation Skills, (4) Hypotheses Development/Alternate Solutions, (5) Problem Solving and (6) Programming. Tables XXVII through XXXII report the individual activities with their rankings and group averages.

All of the eleven exports expressed agreement with the rankings in four areas. These were: (1) Brainstorming, (2) Group Cooperation Skills, (3) Hypotheses Development/Alternate Solutions, and (4) Problem Solving.

Ten of eleven experts agreed with the ranking of activities for Computer Applications as Tools for Solving Problems. The one expert who disagreed with one ranking shared this comment: "Communications via modem is a more useful, understandable and appropriate skill for elementary and junior high students."

Nine of the eleven experts agreed with the ranking of activities for Programming, as related to the topic of Problem Solving. "Design a Flow Chart" was ranked from seven to three by one of the experts who wrote this comment. "Using flowcharts helps younger students to actually see the sequence of events and alternate solutions."

TABLE XXVII

RANKS AND GROUP AVERAGES OF "BRAINSTORMING " ACTIVITIES IN PROBLEM SOLVING CONTENT AREA

Rank No.	Topic	Group Average
1.	Prewriting lessons	4.36
2.	Development of group techniques	4.27
3.	Simulation of historical decision	3.82
4.	Student composition of math word problem	

TABLE XXVIII

RANKS AND GROUP AVERAGES OF "COMPUTER APPLICATIONS AS TOOLS FOR SOLVING PROBLEMS" ACTIVITIES IN PROBLEM SOLVING CONTENT AREA

Rank No.	Topic	Group Average
1.5	Use a database to locate information to answer questions	4.64
1.5	Use a database to make hypotheses and predictions	4.64
3.	Use a spreadsheet to make estimations	4.27
4.	Use spreadsheets to study patterns	4.09
5.5	Use a modem to communicate with another school	4.00
5.5	Use spreadsheets to ask "what if" questions	4.00

TABLE XXIX

RANKS AND GROUP AVERAGES OF "GROUP COOPERATION SKILLS" ACTIVITIES IN PROBLEM SOLVING CONTENT AREA

Rank No.	Topic	Group Average
1.	Write a group-generated story	4.82
2.	Student store simulation	4.36
3.	Model construction	3.82
5.	Plan an alternate bus route schedule	3.64
5.	Design a space station	3.64
5.	Develop a balanced nutrition/exercise program for class	3.64
7.	Study mapping skills	3.55

TABLE XXX

RANKS AND GROUP AVERAGES OF "HYPOTHESES DEVELOPMENT/ALTERNATE SOLUTIONS" ACTIVITIES IN PROBLEM SOLVING CONTENT AREA

Rank No.	Topic	Group Average
1.	Laboratory experiments/investigations	4.73
2.	Biology/botany (plant growth unit)	4.64
3.	Using logic in math activities	4.36
4.	Unit on logic discrimination and strategies	4.27
5.	Unit on Presidential elections	3.82
6.	Nutrition study unit	3.55

TABLE XXXI

RANKS AND GROUP AVERAGES OF "PROBLEM SOLVING" ACTIVITIES IN PROBLEM SOLVING CONTENT AREA

Rank No.	Topic	Group Average
1.5	Use programs that develop logic and memory	4.55
1.5	Exploring situational simulation programs	4.55
3.	Word problems	4.27
4.5	Gaming strategies	4.18
4.5	Writing activities to develop different styles	4.18
6.5	Reading/decoding messages	4.0
6.5	Geography/mapping lessons	4.0
8.	Hierarchy of operations	3.55
9.	Coordinate graphing activity	3.45
10.	Apply/practice metric measures	3.18

TABLE XXXII

RANKS AND GROUP AVERAGES OF "PROGRAMMING" ACTIVITIES IN PROBLEM SOLVING CONTENT AREA

Rank No.	Topic	Group Average
1.	Develop sequencing skills, logical processes	4.55
2.	Logo unit on shapes	4.36
3.	Modify a problem solution to different situations	4.18
4.5	Define a problem	4.09
4.5	Design a problem solution	4.09
6.	Evaluate and adjust problem solutions	4.00
7.	Design a flow chart	3.64

Programming. Six areas for curriculum integration activities were suggested by the experts under the computing content area of Programming.

These were: (1) Program Documentation/Error Tracking, (2) Languages (BASIC, Logo), (3) Programming of Speech Synthesizers, (4) Programming Tutorials/ Problem Solving Software, (5) Top Down Programming, and (6) Using Algorithms for Solving Problems. Tables XXXIII through XXXVIII report the individual activities with their rankings and group averages.

A high degree of consensus in ranking order existed for these six activity areas. All eleven of the experts agreed with the ranking order of five areas. Ten of the eleven experts agreed with the ranking order of activities in the area of Top Down Programming.

TABLE XXXIII

RANKS AND GROUP AVERAGES OF "PROGRAM DOCUMENTATION/ ERROR TRACKING/EDITING" ACTIVITIES IN PROGRAMMING CONTENT AREA

Rank No.	Topic	Group Average
1.	Editing and revising writing activities	4.45
2.	Develop scavenger hunt type activity using documentation	3.45
3.5	Trace a program to find logic errors	3.27
3.5	Word problems	3.27
5.5	Experiment reporting	3.18
5.5	Quiz students on various computer functions and have them find solutions in the documentation	3.18

TABLE XXXIV

RANKS AND GROUP AVERAGES OF "LANGUAGES (BASIC, LOGO)" ACTIVITIES IN PROGRAMMING CONTENT AREA

Rank No.	Topic	Group Average
1.	Use of Logo in simple geometry	4.55
2.	Write an illustrated, interactive story with sprites (LogoWriter)	4.36
3.	Write Logo/BASIC program	3.91
4.5	Text/graphics illustrations lesson	3.45
4.5	Use and vocabulary of programming	3.45
6.	Develop seasonal graphics programs	3.36
7.	Write program for calculating averages	3.27
8.	Invite a programming engineer to speak to the class	3.00
9.5	Write poetry using programming techniques	2.91
9.5	Calculation activities	2.91

TABLE XXXV

RANKS AND GROUP AVERAGES OF "PROGRAMMING OF SPEECH SYNTHESIZERS, ROBOTS AND OTHER PERIPHERALS" ACTIVITIES IN PROGRAMMING CONTENT AREA

Rank No.	Topic	Group Average
1.	Lego Logo unit	4.55
2.5	Use computer in school foyer to advertise PTA meetings, etc.	4.09
2.5	Assemble and program a small commercial robot	4.09
4.	Use computers to recite student poetry	3.36
5.	Develop conversation between two speech synthesizers	2.82

TABLE XXXVI

RANKS AND GROUP AVERAGES OF "PROGRAMMING TUTORIALS/ PROBLEM-SOLVING SOFTWARE" ACTIVITIES IN PROGRAMMING CONTENT AREA

Rank No.	Topic	Group Average
1.	Logic software	4.00
2.	Simulation software for finance lesson	3.64
3.	Students use basic task cards	2.73
4.	Use BASIC editing functions with poetry	2.27

TABLE XXXVII

RANKS AND GROUP AVERAGES OF "TOP DOWN PROGRAMMING" ACTIVITIES IN PROGRAMMING CONTENT AREA

Rank No.	Topic	Group Average
1.	Lesson sequencing/following directions	4.27
2.5	Complete a project in steps, procedures with sub procedures	3.82
2.5	Flowcharting activities	3.82
4.	Testing and debugging a program	3.64
5.	Writing style activity	3.27

TABLE XXXVIII

RANKS AND GROUP AVERAGES OF "USING ALGORITHMS FOR SOLVING PROBLEMS" ACTIVITIES IN PROGRAMMING CONTENT AREA

Rank No.	Topic	Group Average
1.	Have students give and take instructions	4.27
2.	Use logic and problem solving software	4.18
3.5	Make a flowchart to solve a specific problem	3.82
3.5	Design a simple program, then modify it to provide same outcome	3.82
5.	Program a speech synthesizer to give sequential instructions	3.09
6.	Use graphics pad to practice drawing flowchart symbols	1.82

SUMMARY

This study utilized the expertise of eleven recognized educational computing experts to participate in a Delphi study to develop an elementary computing integration model for laboratory computing teachers. The model was created for use in grades K-8 to assist with the integration of computer education into the traditional curriculum areas of language arts, mathematics, science and social studies.

Three questionnaires were designed to gather information for the development of this model. Using Questionnaire One, experts identified five computing content areas. The experts then developed topics and curriculum integration activities that corresponded with each content area. In Questionnaire Two, the experts rated the topics and activities on a five point continuum

according to how these topics and activities supported the curriculum. Questionnaire Three consisted of rankings and group averages of the topics and activities. Experts examined the rankings, made ranking changes that were warranted, and wrote comments that further clarified the ranking changes.

CHAPTER V

SUMMARY, IMPLICATIONS OF THE STUDY AND RECOMMENDATIONS FOR FURTHER RESEARCH

Summary

The objective of this study was to develop a computer integration model for laboratory computing teachers in the elementary (K-8) school. Using a modified Delphi technique, the investigator sought the collective opinion of eleven leading educational computing experts. Based on a review of the literature, the investigator identified eight major instructional computing content areas that were appropriate for the elementary computing curriculum. In building a computer integration model, experts' responses were solicited for three areas: (1) to more acutely define the computing content area that could be used to support computing instruction in elementary schools; (2) to develop instructional topics within each computing content area that best supports instruction in that content area; and (3) to identify activities in which laboratory computing teachers integrated the computing content areas into the traditional elementary curriculum subject areas of language arts, mathematics, science and social studies.

Eleven experts representing a cross-section of the major geographical areas of the nation participated in this study. Three rounds of correspondence in the form of questionnaires were used.

Analysis of Questionnaire One refined the original eight computing content areas that had been identified through a review of the literature to support computing instruction in elementary schools. The five content areas were (a) Applications/Tools, (b) Computer Operations/Keyboarding, (c) Computers and Their Role in a Technological Society, (d) Problem Solving, and (e) Programming. A compilation of computing topics and curriculum integration activities that related to these five computing content areas were developed from Questionnaire One. In the next correspondence, Questionnaire Two, the experts examined each set of computing topics and curriculum integration activities. The experts rated each computing topic and integration activity on a five point continuum ranging from low support (1) to high support (5) , according to how the computing topic or integration activity supported instruction for the computing content areas and for the computing topics. An average group rating for each computing topic and integration activity was calculated from the analysis of Questionnaire Two. Based on the average ratings, Questionnaire Three presented a ranked listing of computing topics and integration activities for each computing content area. Questionnaire Three provided closure for the study and asked the experts to examine the rankings of each set of computing topics and curriculum integration activities that related to the content areas and determine if any significant changes were to be made. The experts also made comments supporting the ranking changes to be made. Analysis of Questionnaire Three culminated in the development of a computer integration model for laboratory computing teachers in the elementary school.

Implications of the Study

The result of this study, a computer integration model, will be of assistance to laboratory computing teachers in the elementary schools who are attempting to integrate computing across the curriculum areas of language arts, mathematics, social studies and science. The model will also assist curriculum coordinators and other teacher educators in directing their efforts in curriculum reform and teacher preparedness. This computer integration model should, however, be of interest to all educators who are even remotely involved with computer use and integration into the curriculum. The literature clearly indicated the need for educators to examine alternative uses of computers as a tool for learning.

For those schools with laboratory computing teachers, the computing content has been varied and inconsistent from school to school (Becker, 1986). This computer integration model reflects a consensus from eleven computing experts across the nation and offers insight into the field of elementary educational computing on a broad basis. Because no standardization of computing instruction has been established in elementary schools, the development of specific computing content areas for use by all classroom computing teachers will ultimately result in the enhancement of learning opportunities for children. This model allows for flexible interpretation and adjustments for its adaptation to elementary laboratory computing classrooms with respect to individual circumstances.

Recommendations for Further Research

The results of this study indicated the following suggestions further research:

1. Researchers in a similar investigation should conduct a pilot study to further refine the list of topics and activities that were suggested for each computing content area. A larger sample of laboratory computing teachers and teacher educators would enhance the credibility of the list of topics and activities that were suggested. A follow-up Delphi study could be utilized to determine more detailed results and could more successfully investigate the refinement and expansion of this model.
2. After topics and activities have been refined and expanded through a follow-up study, an investigation should be undertaken to formulate goals and objectives for topics and activities in each computing content area. This would (a) provide insight into the appropriateness of various curriculum integration activities as related to specific grade levels and (b) identify how these topics and activities could be more effectively integrated across the traditional elementary curriculum areas of language arts, mathematics, science and social studies.
3. Another area of research suggested by this study would be to compare how two different computing laboratory teachers would implement this model. This could focus on teacher perceptions of the importance of specific activities and integration techniques. A study of this type would

offer alternative methods for using this model in various classroom atmospheres.

4. Finally, the model that has resulted from this investigation could be used as a basis for a teacher training course. The information could be expanded to produce modules or units of study related to the topics and activities that teachers incorporate into their specific elementary school curriculum.

Concluding Remarks

Through this study, a computer integration model for elementary laboratory computing teachers was established. It should be noted that, although the sample utilized for the study consisted of only eleven subjects, these "subjects" were nationally recognized educational computing experts. This important factor significantly escalates the quality of the resulting model. With the establishment of the five computing content areas and examples of correlated instructional topics and curriculum integration activities, laboratory computing teachers will have a tool that enables them to more specifically develop goals and objectives for their individual instructional needs in the classroom.

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APPENDIXES

APPENDIX A

CORRESPONDENCE NUMBER ONE

1843 S. 124 E. Ave.
Tulsa, OK 74128
September 18, 1987

Dear

I am a doctoral student at Oklahoma State University in the Department of Curriculum and Instruction. My specific area of emphasis is Information/Communications Technology. I am in the process of completing a research study that, I believe, will be a valuable curriculum contribution to elementary school computer education programs and to teacher educators. As an expert in your area, the information that you contribute will be carefully analyzed and your collective ideas will be used to develop a computer curriculum model which can serve as a guide for educators.

The Delphi technique will be the method used to obtain your ideas. The goal of this research process is to achieve consensus of opinion on a given topic but it does not require that all of the experts be brought together to achieve this consensus. The technique will provide a clear picture of how other experts respond to the same questions you will be considering. The study will involve no cost to you, only a small time commitment. Three separate instrument forms will be used to gather and finalize your collective input. Questionnaire #1, which will require the most time, will be used to identify issues related to integration and use of computers in the elementary curriculum (K-8). The second questionnaire will be a composite of the experts' responses to Questionnaire #1 whereby participants will be asked to rank order responses and provide clarification, supportive statements and/or criticisms. In the final phase, a collective opinion of all participants will be known and an opportunity will be provided to express individual judgments.

The first instrument form is attached. I appreciate your willingness to participate in this study and to become an integral part of this effort to develop a computer curriculum model for use in the area of elementary education. Your statements are considered confidential and will only be used as part of a composite total. As soon as this data is summarized, I will contact you for the second phase.

Sincerely yours,

Joan F. Junger

Joan F. Junger

bcl
attachment

DELPHI QUESTIONNAIRE #1

In general, elementary schools are in a state of confusion concerning how to effectively integrate computers into their curriculum. None of the computer curriculum models that have been identified to possess appropriate content at the elementary level have addressed how this content is related to the existing curriculum in mathematics, language arts, science and social studies. The development of a comprehensive computer curriculum model will address the computing content areas that can be integrated to provide computing across the elementary curriculum (K-8).

INSTRUCTIONS FOR RESPONDING TO DELPHI QUESTIONNAIRE #1

Please read all questions before responding.

Review each of the following computer curriculum content areas that were identified through the literature by the investigator. This study intends to seek a consensus of experts' opinions on:

a) agreement of computing content areas to be taught at the elementary level (K-8),
b) a list of most appropriate topics for each area, and
c) examples of curriculum integration techniques for each computing content area.

The questions in this Delphi lend themselves to three response columns. The left-hand column is entitled "Computing Content Area". Listed under this column are eight general computing content areas that have been identified by the literature. Under this column, please indicate your feelings with regard to your agreement or disagreement of the accuracy of these computing content areas.

The middle column is entitled "Topic". In this area, please record one or more computer curriculum topics that you feel are appropriate for each computing content area. If you feel that topics are not unique to one content area, please feel free to list topics in more than one content area.

The third column, "Curriculum Integration Techniques", asks for at least two examples of activities/techniques appropriate for each topic in column 2. Answers should be brief. Your responses in the three columns will provide the investigator a means of viewing the answers to ensure that they are not misinterpreted. The investigator has provided a sample response to clarify the type of information to be placed in each column.

Please have the completed questionnaire in the mail to me by October 12, 1987. A self-addressed, stamped envelope has been enclosed for your convenience.

QUESTIONNAIRE #1

September 18, 1987

Return by October 12, 1987

1. Think about the role of the elementary computer teacher and/or the teacher educator/in-service trainer.

   A. Do you agree that these are the primary computing content areas for the elementary grades (K-8)? Please record any changes and/or additions below and then make necessary changes in content areas for the remaining questions.

Content Areas	Changes/Additions
1. Applications	
2. Careers	
3. Past, Present and Future Technologies	
4. Keyboarding	
5. Problem Solving	
6. Programming	
7. Social/Ethical Issues	
8. Vocabulary/Computer Operations	

2. Think about general topics that you consider to be a part of each content area that are appropriate for each grade level.

   A. Record each of these topics in the column adjacent to the appropriate computing content area. (Be sure to record any content area changes from Question 1).

   B. For each topic, list at least two examples that indicate what you feel are appropriate curriculum integration techniques. If additional space is needed, please write on the back of each content page.

Computing Content Area	Topic	Curriculum Integration Technique
1. Applications	a. Word Processing	1a. Poetry Unit
		2a. Letter Writing
	b. Databases	1b. Animal Classifications
		2b. Study of Presidents

Computing Content Area	Topic	Curriculum Integration Technique
2. Careers	a.	1a. 2a.
	b.	1b. 2b.

Computing Content Area	Topic	Curriculum Integration Technique
3. Past, Present and Future Technologies	a.	1a. 2a.
	b.	1b. 2b.

Computing Content Area	Topic	Curriculum Integration Technique
4. Keyboarding	a.	1a. 2a.
	b.	1b. 2b.

Computing Content Area	Topic	Curriculum Integration Technique
5. Problem-Solving	a.	1a. 2a.
	b.	1b. 2b.

Computing Content Area	Topic	Curriculum Integration Technique
6. Programming	a.	1a. 2a.
	b.	1b. 2b.

Computing Content Area	Topic	Curriculum Integration Technique
7. Social/Ethical Issues	a.	1a.
		2a.
	b.	1b.
		2b.

Computing Content Area	Topic	Curriculum Integration Technique
8. Vocabulary/Computer Operations	a.	1a. 2a.
	b.	1b. 2b.

APPENDIX B

CORRESPONDENCE NUMBER TWO

1843 S. 124 E. Ave.
Tulsa, OK 74128
November 12, 1987

Dear

Thank you for completing the first of three questionnaires in this Delphi study concerning building a computing curriculum model for the elementary computing teacher. Your input has been invaluable in compiling the second questionnaire.

This study was initiated to assist elementary teachers designated as computing teachers in their schools to integrate computing content areas across the traditional elementary curriculum. In many schools across the country, elementary school teachers are being placed in computing laboratory situations with the responsibility of developing units of instruction for multi-sections of students. The investigator recognizes that this perspective is only one alternative for integrating computing within elementary schools and does not necessarily represent the ideal. The results from this Delphi investigation will give direction and guidance to elementary computing teachers in building a computing curriculum model that is integrated with elementary mathematics, science, language arts, and social studies.

Focusing on the needs of the elementary teacher who has been assigned to teach computing full time, the second phase of this study seeks your expert opinion concerning the appropriateness of the (a) computing topics included in each computing content area and (b) curriculum integration activities selected to support the individual topics. Based on a consensus of your opinions, the following computing content areas have been selected and will be used throughout the second and third phases of this study. They are:

1. APPLICATIONS / TOOLS
2. COMPUTER OPERATIONS /KEYBOARDING
   (This represents two original content categories - Keyboarding - and Vocabulary / Computer Operations)
3. COMPUTERS and THEIR ROLE IN A TECHNOLOGICAL SOCIETY
   (This represents three original content categories - Careers - Past, Present, & Future Technology - and Social / Ethical Issues)
4. PROBLEM SOLVING
5. PROGRAMMING

Questionnaire #2 (see enclosed) represents a composite of your responses from the first questionnaire and has been divided in two parts to present the information clearly and precisely.

PART A - Composite of topics supporting each computing content area (white document)
PART B - Composite of curriculum integration activities supporting the individual topics in each computing content area (multi-colored document).

Please follow the specific directions for parts A and B and return both documents (white and multi-colored) in the enclosed envelope by **NOVEMBER 25, 1987.** Again, I want to thank you for your time and continued assistance in this project.

Sincerely yours,

Joan Junger

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PART A

APPLICATIONS/TOOLS

Below are the combined topics that were suggested for this content area. In order for a priority to be determined, please rank each topic (on a five point continuum) based on how you feel the topic supports the specific content area. Indicate your response by marking the desired blank for each topic, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Databases	___	___	___	___	___
Electronic Spreadsheets	___	___	___	___	___
Graph/Animation/Chart/Printing/ Survey Tool Utility/Packages	___	___	___	___	___
Programming	___	___	___	___	___
Telecommunications	___	___	___	___	___
Peripheral Tools	___	___	___	___	___
Word Processing	___	___	___	___	___

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COMPUTER OPERATIONS/KEYBOARDING

Below are the combined topics that were suggested for this content area. In order for a priority to be determined, please rank each topic (on a five point continuum) based on how you feel the topic supports the specific content area. Indicate your response by marking the desired blank for each topic, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Develop Speed and Accuracy	___	___	___	___	___
Disk Handling	___	___	___	___	___
Operating System Commands	___	___	___	___	___
Proper Keyboarding	___	___	___	___	___
System Components (Hardware)	___	___	___	___	___
Vocabulary Development	___	___	___	___	___
Use of Software Documentation	___	___	___	___	___

PART A (continued)

COMPUTERS and THEIR ROLE IN A TECHNOLOGICAL SOCIETY (CAREERS/PAST, PRESENT, FUTURE TECHNOLOGIES/SOCIAL-ETHICAL ISSUES)

Below are the combined topics that were suggested for this content area. In order for a priority to be determined, please rank each topic (on a five point continuum) based on how you feel the topic supports the specific content area. Indicate your response by marking the desired blank for each topic, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Communications/Telecommunications	___	___	___	___	___
Computers and the Handicapped	___	___	___	___	___
Computers in the Workplace	___	___	___	___	___
Computers in Our Future	___	___	___	___	___
Copyright Laws/Computer Crime/Privacy	___	___	___	___	___
Equity in Computer Usage	___	___	___	___	___
History of Technology	___	___	___	___	___

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PROBLEM SOLVING

Below are the combined topics that were suggested for this content area. In order for a priority to be determined, please rank each topic (on a five point continuum) based on how you feel the topic supports the specific content area. Indicate your response by marking the desired blank for each topic, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Brainstorming	___	___	___	___	___
Computer Applications as Tools for Solving Problems (i.e. databases/spreadsheets)	___	___	___	___	___
Group Cooperation Skills	___	___	___	___	___
Hypotheses Development/Alternate Solutions	___	___	___	___	___
Problem Solving Software	___	___	___	___	___
Programming	___	___	___	___	___

PART A (continued)

PROGRAMMING

Below are the combined topics that were suggested for this content area. In order for a priority to be determined, please rank each topic (on a five point continuum) based on how you feel the topic supports the specific content area. Indicate your response by marking the desired blank for each topic, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Languages (BASIC, Logo)	___	___	___	___	___
Program Documentation/Error Tracking/ Editing	___	___	___	___	___
Programming of Speech Synthesizers, Robots and Other Peripherals	___	___	___	___	___
Programming Tutorials/Problem Solving Software	___	___	___	___	___
Top Down Programming	___	___	___	___	___
Using Algorithms for Solving Problems	___	___	___	___	___

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PART B

APPLICATIONS/TOOLS

1. Databases

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Mapping skills	___	___	___	___	___
Politics unit	___	___	___	___	___
Study Presidential bibliographies	___	___	___	___	___
Global geographical study and classification of countries	___	___	___	___	___
Research of the states	___	___	___	___	___
Animal classifications unit	___	___	___	___	___
Preparing student polls	___	___	___	___	___
Categorize book reviews, reports	___	___	___	___	___
Record weather information	___	___	___	___	___
Develop student identification list	___	___	___	___	___
Gather, sort and process information for projects and reports	___	___	___	___	___
Planetary studies	___	___	___	___	___
Study of dinosaurs	___	___	___	___	___
Study of community/state	___	___	___	___	___
Rocks/minerals classifications unit	___	___	___	___	___

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2. Electronic Spreadsheets

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Keep records for school club and/or make-believe business	___	___	___	___	___
Financial or numeric data collection	___	___	___	___	___
Study of math formulas/story problems	___	___	___	___	___
Study of banking and currency	___	___	___	___	___
Unit on decimals and percents	___	___	___	___	___
Unit on problem solving with estimation/ calculation skills	___	___	___	___	___
Unit on balancing a checkbook	___	___	___	___	___

PART B (continued)

3. Graph/Animation/Chart/Printing/Survey Tool Utility Packages

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Illustration of reports and projects	___	___	___	___	___
Development of timeline activities	___	___	___	___	___
Use with traditional art activities	___	___	___	___	___
Graph calendar and/or weather information	___	___	___	___	___
Animation activities	___	___	___	___	___
Chart the number of manned space flights per year	___	___	___	___	___
Language analysis using parts of speech	___	___	___	___	___
Plot modes of transportation to school	___	___	___	___	___
Chart the population of countries	___	___	___	___	___
Calculate distribution of parents' occupations	___	___	___	___	___
Teach scientific observation/measurement and hypothesis	___	___	___	___	___
Chart distribution of different colors of M&M's in a package	___	___	___	___	___
Make math (or other content area) slide show with graphs	___	___	___	___	___
Create signs and advertisements	___	___	___	___	___

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4. Programming

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Create math story problems	___	___	___	___	___
Study algorithms of simple mathematics formulas	___	___	___	___	___
Vocabulary unit on programming concepts/ fundamentals	___	___	___	___	___
Use LogoWriter to develop/illustrate language story	___	___	___	___	___

PART B (continued)

5. Telecommunications

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Electronic mail communications	___	___	___	___	___
Create journal/diary	___	___	___	___	___
Develop research/library skills	___	___	___	___	___
Compare cultures with pen pals	___	___	___	___	___

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6. Peripheral Tools

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Use self-contained keyboard synthesizers	___	___	___	___	___
Use joystick/mouse devices with games and simulation activities	___	___	___	___	___
Use graphics tablets to make pictures and signs	___	___	___	___	___
Use touch window technologies in any content area	___	___	___	___	___
Communicate conversations through synthesizers interfaced with micros	___	___	___	___	___

PART B (continued)

7. Word Processing

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Writing process unit (concepts)	___	___	___	___	___
Creative writing activity	___	___	___	___	___
Journalism/newspaper unit	___	___	___	___	___
Classroom newsletter	___	___	___	___	___
Keyboarding practice activities (dialog, math story problems)	___	___	___	___	___
Parts of speech unit	___	___	___	___	___
Write research reports	___	___	___	___	___
Poetry unit	___	___	___	___	___

COMPUTER OPERATIONS/KEYBOARDING

Develop Speed and Accuracy

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Typing practice exercises	___	___	___	___	___
Use typing tutorials/software	___	___	___	___	___
Invite school secretary to speak about keyboarding and importance of computers in the office	___	___	___	___	___
Focus a lesson on occupations that require employees to consistently use keyboarding skills	___	___	___	___	___

_____

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Disk Handling

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Unit on magnetics and the impact on diskettes	___	___	___	___	___
Lesson on appropriate use of software	___	___	___	___	___
Dissect a disk to demonstrate its parts	___	___	___	___	___
Study how information is placed on diskette	___	___	___	___	___
Write letters to a diskette manufacturer to get information and trends about diskette use	___	___	___	___	___
Diskette preparation for information storage	___	___	___	___	___

Operating System Commands

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Read/discuss children's book on computer operations	___	___	___	___	___
Conduct computer work session (save, load, delete from disk)	___	___	___	___	___
Practice copying a public domain disk	___	___	___	___	___
Program debugging activities	___	___	___	___	___

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Proper Keyboarding
(Finger Position/Memory Skills/Word, Paragraph Spacing)

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Use language development software	___	___	___	___	___
Discuss topic poster	___	___	___	___	___
Use copy of a practice keyboard	___	___	___	___	___
Unit on keyboarding	___	___	___	___	___
Spelling, reading or handwriting lesson	___	___	___	___	___
Revision process lessons	___	___	___	___	___
Skill development toward the development of writing skills	___	___	___	___	___
P.E. activities that develop good body positioning	___	___	___	___	___
Use regular handwriting lessons to develop finger strength	___	___	___	___	___

System Components (Hardware)

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Reading/spelling activities	___	___	___	___	___
Simulation activities illustrating input/ process/output	___	___	___	___	___
Identification/care of components	___	___	___	___	___
Study computer mathematical functions	___	___	___	___	___

_____

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Vocabulary Development

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Crossword puzzle	___	___	___	___	___
Student-generated glossary/pictionary	___	___	___	___	___
Match word with definition	___	___	___	___	___
Use game-type formats to develop skills	___	___	___	___	___
Spelling unit	___	___	___	___	___
Science technology unit	___	___	___	___	___
Activity focusing on contextual use of words	___	___	___	___	___

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Use of Software Documentation

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Reference skills	___	___	___	___	___
Reading comprehension skills	___	___	___	___	___
Lesson on following directions	___	___	___	___	___

1

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL-ETHICAL ISSUES)

Communications/Telecommunications

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Modem and cable TV use	___	___	___	___	___
Use of computerized card catalog in a library	___	___	___	___	___
Create a student newspaper	___	___	___	___	___
Develop class story books	___	___	___	___	___
Biography writing unit on famous people	___	___	___	___	___
Research a newspaper article about computer crime	___	___	___	___	___
Science fiction story writing	___	___	___	___	___
Study the history of the American expansion	___	___	___	___	___

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Computers and the Handicapped

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Watch a videotape illustrating new technologies	___	___	___	___	___
Health unit on special needs of the handicapped	___	___	___	___	___
Discuss related articles, books, movies	___	___	___	___	___
Invite guest speaker to classroom	___	___	___	___	___
Study of community helpers	___	___	___	___	___

Computers in the Workplace

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Unit on transportation	___	___	___	___	___
Password game to identify occupations	___	___	___	___	___
Study of technology uses in the community	___	___	___	___	___
Inventions/inventors unit	___	___	___	___	___
Design and print pictures of computer use in businesses	___	___	___	___	___
Discuss calculators and "manual vs. mechanical" issues	___	___	___	___	___
Compare various computer companies by size, structure and products	___	___	___	___	___
Match job titles with descriptions	___	___	___	___	___
Write a report on computer careers	___	___	___	___	___
Interview speaker from technology professionals	___	___	___	___	___
Unit on forecasting financial situations	___	___	___	___	___
Banking unit	___	___	___	___	___
Computers in the entertainment industry	___	___	___	___	___

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Computers in Our Future

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Read stories and brainstorm	___	___	___	___	___
Science fiction unit	___	___	___	___	___
Unit on the "house of the future"	___	___	___	___	___
Use graphics software to design the structure of a house of the future	___	___	___	___	___
Artificial intelligence unit	___	___	___	___	___
Studies on space travel and astronomy	___	___	___	___	___
Unit on robotics					

Copyright Laws/Computer Crime/Privacy

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Discussion of copyright laws as related to all content areas	___	___	___	___	___
Role play classroom lesson on illegal copying of software	___	___	___	___	___
Values clarification activity	___	___	___	___	___
Write essay about misuse of computer data	___	___	___	___	___
Communications/journalism unit	___	___	___	___	___
Unit on U.S./local government	___	___	___	___	___
Discuss use of modems for data transfer	___	___	___	___	___
Legal/social implications on use of large databases (i.e. social security/drivers license bureau)	___	___	___	___	___
Unit on criminal justice system	___	___	___	___	___

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Equity in Computer Usage

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Study effects of employment	___	___	___	___	___
Compare and contrast cultural differences	___	___	___	___	___
Study of women and/or minorities in the workplace	___	___	___	___	___
Survey of student usage of computers in the school	___	___	___	___	___
Survey of student preferences in software	___	___	___	___	___

4

History of Technology

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Unit on mainframes, minis, micros	___	___	___	___	___
Biographical studies of key people in the development of technology	___	___	___	___	___
Create database using information on the generations of computers	___	___	___	___	___
Develop a timeline or wall chart of the generations of computers	___	___	___	___	___
Invite a guest speaker from the community	___	___	___	___	___
Compare trends in computing to agricultural and industrial development	___	___	___	___	___

1

PROBLEM SOLVING

Brainstorming

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Prewriting lessons	___	___	___	___	___
Simulation of historical decision	___	___	___	___	___
Student composition of math word problem	___	___	___	___	___
Development of group techniques	___	___	___	___	___

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Computer Applications as Tools for Solving Problems (i.e. Databases/Spreadsheets)

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Use a database to locate information to answer questions	___	___	___	___	___
Use a spreadsheet to make estimations	___	___	___	___	___
Use a modem to communicate with another school	___	___	___	___	___
Use a database to make hypotheses and predictions	___	___	___	___	___
Use spreadsheets to ask "what if" questions	___	___	___	___	___
Use spreadsheets to study patterns	___	___	___	___	___

Group Cooperation Skills

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Study mapping skills	___	___	___	___	___
Model construction					
Student store simulation	___	___	___	___	___
Plan an alternate bus route schedule	___	___	___	___	___
Design a space station	___	___	___	___	___
Develop a balanced nutrition/exercise program for class	___	___	___	___	___
Write a group-generated story	___	___	___	___	___

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Hypotheses Development/Alternate Solutions

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Biology/botany (plant growth unit)	___	___	___	___	___
Unit on logic discrimination and strategies	___	___	___	___	___
Using logic in math activities	___	___	___	___	___
Nutrition study unit	___	___	___	___	___
Unit on Presidential elections	___	___	___	___	___
Laboratory experiments/investigations	___	___	___	___	___

Problem-Solving Software

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Gaming strategies	___	___	___	___	___
Hierarchy of operations	___	___	___	___	___
Reading/decoding messages	___	___	___	___	___
Word problems	___	___	___	___	___
Use programs that develop logic and memory	___	___	___	___	___
Coordinate graphing activity	___	___	___	___	___
Exploring situational simulation programs	___	___	___	___	___
Apply/practice metric measures	___	___	___	___	___
Geography/mapping lessons	___	___	___	___	___
Writing activities to develop different styles	___	___	___	___	___

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Programming

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Design a flow chart	___	___	___	___	___
Logo unit on shapes	___	___	___	___	___
Develop sequencing skills, logical processes	___	___	___	___	___
Define a problem	___	___	___	___	___
Design a problem solution	___	___	___	___	___
Evaluate and adjust problem solutions	___	___	___	___	___
Modify a problem solution to different situations	___	___	___	___	___

1

PROGRAMMING

Program Documentation/Error Tracking/Editing

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Trace a program to find logic errors	___	___	___	___	___
Experiment reporting	___	___	___	___	___
Word problems	___	___	___	___	___
Editing and revising writing activities	___	___	___	___	___
Develop scavenger-hunt type activity using documentation	___	___	___	___	___
Quiz students on various computer functions and have them find solutions in the documentation	___	___	___	___	___

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Languages (BASIC, Logo)

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Text/graphics illustrations lesson	___	___	___	___	___
Use and vocabulary of programming	___	___	___	___	___
Write Logo/BASIC program	___	___	___	___	___
Write poetry using programming techniques	___	___	___	___	___
Develop seasonal graphics programs	___	___	___	___	___
Calculation activities	___	___	___	___	___
Use of Logo in simple geometry	___	___	___	___	___
Write program for calculating averages	___	___	___	___	___
Invite a programming engineer to speak to the class	___	___	___	___	___
Write an illustrated, interactive story with sprites (LogoWriter)	___	___	___	___	___

Programming of Speech Synthesizers, Robots and Other Peripherals

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Lego Logo unit	___	___	___	___	___
Use computers to recite student poetry	___	___	___	___	___
Develop conversation between two speech synthesizers	___	___	___	___	___
Use computer in school foyer to advertise PTA meetings, etc.	___	___	___	___	___
Assemble and program a small commercial robot					

_____

_____

Programming Tutorials/Problem-Solving Software

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Simulation software for finance lesson	___	___	___	___	___
Logic software	___	___	___	___	___
Students use basic task cards	___	___	___	___	___
Use BASIC editing functions with poetry	___	___	___	___	___

Top Down Programming

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Lesson sequencing/following directions	___	___	___	___	___
Writing style activity	___	___	___	___	___
Complete a project in steps, procedures with sub procedures	___	___	___	___	___
Flowcharting activities	___	___	___	___	___
Testing and debugging a program	___	___	___	___	___

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Using Algorithms for Solving Problems

Below are the combined curriculum integration activities that were suggested for this topic. In order for a priority to be determined, please rank each activity (on a five point continuum) based on how you feel the activity supports the traditional elementary curriculum. Indicate your response by marking the desired blank for each activity, where 1 represents low support and 5 represents high support.

	Low Support 1	2	3	4	High Support 5
Make a flowchart to solve a specific problem	___	___	___	___	___
Have students give and take instructions	___	___	___	___	___
Design a simple program, then modify it to provide same outcome	___	___	___	___	___
Use logic and problem solving software	___	___	___	___	___
Program a speech synthesizer to give sequential instructions	___	___	___	___	___
Use graphics pad to practice drawing flowchart symbols	___	___	___	___	___

APPENDIX C

CORRESPONDENCE NUMBER THREE

1843 S. 124 E. Ave.
Tulsa, OK 74128
December 18, 1987

Dear

This Delphi study of computing content areas, topics and integration activities for elementary computer teachers has been very successful! Your valuable contribution of time and expertise has been the major factor in the development of a computer curriculum model that can be used by full-time elementary computer teachers and teacher educators who are integrating computing into the traditional elementary curriculum.

Attached is a ranking of the topics (white document) and curriculum integration activities (multicolored documents) for each of the five areas designated as computing content areas. In this final phase of the Delphi study, **please examine these rankings.** If you believe that some of the topics or activities should be ranked significantly higher or lower, indicate the ranks that you feel would be more appropriate. The color-coded pages are again provided to assist with the sectioning of topics and activities.

Because information generated by experts is the core of this study, I would again encourage you to include your comments as they will be helpful in guiding curriculum decisions in the future. Please use the enclosed envelope to return your questionnaire to me by December 30, 1987.

Thank you for your assistance in providing information to help build a computer integration curriculum model for elementary school educators. As soon as all of the data is compiled, I will send you a summary.

Sincerely yours,

Joan F. Junger

bcl
enclosure

PART B

APPLICATIONS/TOOLS

1. Databases

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Study of community/state	4.82
3.	Global geographical study and classification of countries	4.73
3.	Gather, sort and process information for projects and reports	4.73
3.	Study of dinosaurs	4.73
7.	Animal classifications unit	4.64
7.	Preparing student polls	4.64
7.	Record weather information	4.64
7.	Planetary studies	4.64
7.	Rocks/minerals classifications unit	4.64
10.	Research of the states	4.55
11.	Develop student identification list	4.36
12.	Categorize book reviews, reports	4.09
13.	Study Presidential bibliographies	3.91
14.	Politics unit	3.82
15.	Mapping skills	3.00

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

APPLICATIONS/TOOLS

2. Electronic Spreadsheets

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.5	Keep records for school club and/or make-believe business	4.45
1.5	Unit on problem solving with estimation/ calculation skills	4.45
3.5	Study of math formulas/story problems	3.73
3.5	Study of banking and currency	3.73
6.	Unit on decimals and percents	3.55
7.	Financial or numeric data collection	3.36

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

APPLICATIONS/TOOLS

3. Graph/Animation/Chart/Printing/Survey Tool Utility Packages

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.5	Development of timeline activities	4.64
1.5	Chart the population of countries	4.64
3.5	Illustration of reports and projects	4.55
3.5	Teach scientific observation/measurement and hypothesis	4.55
5.5	Graph calendar and/or weather information	4.27
5.5	Make math (or other content area) slide show with graphs	4.27
7.	Use with traditional art activities	4.09
8.	Chart distribution of different colors M&M's in a package	3.91
9.5	Animation activities	3.64
9.5	Create signs and advertisements	3.64
11.5	Plot modes of transportation to school	3.45
11.5	Calculate distribution of parents' occupations	3.45
13.	Chart the number of manned space flights per year	2.82
14.	Language analysis using parts of speech	2.64

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

APPLICATIONS/TOOLS

4. Programming

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Use LogoWriter to develop illustrate language story	4.73
2.	Study algorithms of simple mathematics formulas	3.55
3.	Create math story problems	3.27
4.	Vocabulary unit on programming concepts/ fundamentals	3.00

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

5

PART B (continued)

APPLICATIONS/TOOLS

5. Telecommunications

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Compare cultures with pen pals	4.73
2.	Develop research/library skills	4.36
3.	Electronic mail communications	4.27
4.	Create journal/diary	3.91

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

APPLICATIONS/TOOLS

6. Peripheral Tools

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Use touch window technologies in any content area	3.55
2.	Use joystick/mouse devices with and simulation activities	3.45
3.5	Use self-contained keyboard synthesizers	3.36
3.5	Use graphics tablets to make pictures and signs	3.36
5.	Communicate conversations through synthesizers interfaced with micros	2.73

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

APPLICATIONS/TOOLS

7. Word Processing

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
2.	Writing process unit (concepts)	4.82
2.	Creative writing activity	4.82
2.	Journalism/newspaper unit	4.82
5.	Classroom newsletter	4.64
5.	Write research reports	4.64
5.	Poetry unit	4.64
7.	Keyboarding practice activities (dialog, math story problems)	3.64
8.	Parts of speech unit	2.82

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTER OPERATIONS/KEYBOARDING

1. Develop Speed and Accuracy

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Use typing tutorials/software	4.82
2.	Typing practice exercises	4.73
3.	Focus a lesson on occupations that require employees to consistently use keyboarding skills	3.27
4.	Invite school secretary to speak about keyboarding and importance of computers in the office	3.18

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTER OPERATIONS/KEYBOARDING

2. Disk Handling

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Lesson on appropriate use of software	4.45
2.	Diskette preparation for information storage	4.36
3.	Dissect a disk to demonstrate its parts	4.18
4.5	Unit on magnetics and the impact on diskettes	3.18
4.5	Study how information is placed on diskette	3.18
6.	Write letters to a diskette manufacturer to get information and trends about diskette use	3.09

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTER OPERATIONS/KEYBOARDING

3. Operating System Commands

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Conduct computer work session (save, load, delete from disk)	4.64
2.	Practice copying a public domain disk	4.18
3.	Read/discuss children's book on computer operations	3.55
4.	Program debugging activities	2.55

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTER OPERATIONS/KEYBOARDING

4. Proper Keyboarding

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Unit on keyboarding	4.82
2.5	Revision process lessons	4.55
2.5	Skill development toward the development of writing skills	4.55
4.	Use copy of a practice keyboard	4.09
5.	Use language development software	3.55
6.	Discuss topic poster	3.09
7.	Spelling, reading or handwriting lesson	3.00
8.	P.E. activities that develop good body positioning	2.91
9.	Use regular handwriting lesson to develop finger strength	2.82

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTER OPERATIONS/KEYBOARDING

5. Systems Components (Hardware)

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Identification/care of components	4.45
2.	Simulation activities illustrating input/ process/output	3.36
3.	Reading/spelling activities	2.82
4.	Study computer mathematical functions	1.73

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTER OPERATIONS/KEYBOARDING

6. Vocabulary Development

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Student-generated glossary/pictionary	4.64
2.	Science technology unit	
3.	Activity focusing on contextual use of words	4.09
4.5	Match word with definition	4.00
4.5	Use game-type formats to develop skills	4.00
6.	Crossword puzzle	3.73
7.	Spelling unit	3.55

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTER OPERATIONS/KEYBOARDING

7. Use of Software Documentation

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Lesson on following directions	4.45
2.5	Reference skills	4.09
2.5	Reading comprehension skills	4.09

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL–ETHICAL ISSUES)

1. Communications/Telecommunications

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Modem and cable TV use	4.18
2.	Develop class story books	4.00
3.	Create a student newspaper	3.91
4.	Use of computerized card catalog in a library	3.64
5.	Biography writing unit on famous people	3.45
6.	Science fiction story writing	3.18
7.	Study the history of the American expansion	3.09

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL–ETHICAL ISSUES)

2. Computers and the Handicapped

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Watch a videotape illustrating new technologies	4.27
2.	Invite guest speaker to classroom	4.18
3.	Study of community helpers	3.73
4.	Health unit on special needs of the handicapped	3.55
5.	Discuss related articles, books, movies	3.45

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL–ETHICAL ISSUES)

3. Computers in the Workplace

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Study of technology uses in the community	4.73
2.	Interview speaker from technology professionals	3.91
3.5	Write a report on computer careers	3.73
3.5	Banking unit	3.73
5.	Unit on transportation	3.55
6.5	Inventions/inventors unit	3.45
6.5	Discuss calculators and "manual vs. mechanical" issues	3.45
8.	Computers in the entertainment industry	3.36
9.5	Password game to identify occupations	3.18
9.5	Design and print pictures of computer use in business	3.18
11.	Match job titles with descriptions	2.91
12.5	Compare various computer companies by size, structure and products	2.18
12.5	Unit on forecasting financial situations	2.18

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL–ETHICAL ISSUES)

4. Computers in Our Future

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Read stories and brainstorm	4.64
2.	Unit on the "house of the future"	4.36
3.	Unit on robotics	4.27
4.	Studies on space travel and astronomy	4.18
5.	Science fiction unit	4.09
6.	Use graphics software to design the structure of a house of the future	3.91
7.	Artificial intelligence unit	3.73

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL–ETHICAL ISSUES)

5. Copyright Laws/Computer Crime/Privacy

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Discussion of copyright laws as related to all content areas	4.55
2.	Role play classroom lesson on illegal copying of software	3.64
3.	Legal/social implications on use of large databases (i.e. social security/drivers license bureau)	3.55
4.	Discuss use of modems for data transfer	3.36
5.5	Write essay about misuse of computer data	3.27
5.5	Communications/journalism unit	3.27
7.	Values clarification activity	3.18
8.	Unit on U.S./local government	2.91
9.	Unit on criminal justice system	2.36

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL–ETHICAL ISSUES)

6. Equity in Computer Usage

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Survey of student usage of computers in the school	4.45
2.	Survey of student preferences in software	4.27
3.	Compare and contrast cultural differences	3.36
4.5	Study effects of employment	3.09
4.5	Study of women and/or minorities in the workplace	3.09

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(CAREERS/PAST, PRESENT AND FUTURE TECHNOLOGY/SOCIAL–ETHICAL ISSUES)

7. History of Technology

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Develop a timeline or wall chart of the generations of computers	4.18
2.	Invite a guest speaker from the community	3.91
3.	Compare trends in computing to agricultural and industrial development	3.45
4.	Create database using informations on the generations of computers	3.27
5.5	Unit on mainframes, minis, micros	2.91
5.5	Biographical studies of key people in the development of technology	2.91

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROBLEM SOLVING

1. Brainstorming

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Prewriting lessons	4.36
2.	Development of group techniques	4.27
3.	Simulation of historical decision	3.82
4.	Student composition of math word problem	3.73

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROBLEM SOLVING

2. Computer Applications as Tools for Solving Problems (i.e., databases/spreadsheets)

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.5	Use a database to locate information to answer questions	4.64
1.5	Use a database to make hypotheses and predictions	4.64
3.	Use a spreadsheet to make estimations	4.27
4.	Use spreadsheets to study patterns	4.09
5.5	Use a modem to communicate with another school	4.00
5.5	Use spreadsheets to ask "what if" questions	4.00

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROBLEM SOLVING

3. Group Cooperation Skills

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Write a group-generated story	4.82
2.	Student store simulation	4.36
3.	Model construction	3.82
5.	Plan an alternate bus route schedule	3.64
5.	Design a space station	3.64
5.	Develop a balanced nutrition/exercise program for class	3.64
7.	Study mapping skills	3.55

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROBLEM SOLVING

4. Hypotheses Development/Alternate Solutions

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Laboratory experiments/investigations	4.73
2.	Biology/botany (plant growth unit)	4.64
3.	Using logic in math activities	4.36
4.	Unit on logic discrimination and strategies	4.27
5.	Unit on Presidential elections	3.82
6.	Nutrition study unit	3.55

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROBLEM SOLVING

5. Problem Solving

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.5	Use programs that develop logic and memory	4.55
1.5	Exploring situational simulation programs	4.55
3.	Word problems	4.27
4.5	Gaming strategies	4.18
4.5	Writing activities to develop different styles	4.18
6.5	Reading/decoding messages	4.00
6.5	Geography/mapping lessons	4.00
8.	Hierarchy of operations	3.55
9.	Coordinate graphing activity	3.45
10.	Apply/practice metric measures	3.18

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

6

PART B (continued)

PROBLEM SOLVING

6. Programming

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Develop sequencing skills, logical processes	4.55
2.	Logo unit on shapes	4.36
3.	Modify a problem solution to different situations	4.18
4.5	Define a problem	4.09
4.5	Design a problem solution	4.09
6.	Evaluate and adjust problem solutions	4.00
7.	Design a flow chart	3.64

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROGRAMMING

1. Program Documentation/Error Tracking/Editing

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Editing and revising writing activities	4.45
2.	Develop scavenger hunt type activity using documentation	3.45
3.5	Trace a program to find logic errors	3.27
3.5	Word problems	3.27
5.5	Experiment reporting	3.18
5.5	Quiz students on various computer functions and have them find solutions in the documentation	3.18

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROGRAMMING

2. Languages (BASIC, Logo)

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Use of Logo in simple geometry	4.55
2.	Write an illustrated, interactive story with sprites (LogoWriter)	4.36
3.	Write Logo/BASIC program	3.91
4.5	Text/graphics illustrations lesson	3.45
4.5	Use and vocabulary of programming	3.45
6.	Develop seasonal graphics programs	3.36
7.	Write program for calculating averages	3.27
8.	Invite a programming engineer to speak to the class	3.00
9.5	Write poetry using programming techniques	2.91
9.5	Calculation activities	2.91

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROGRAMMING

3. Programming of Speech Synthesizers, Robots and Other Peripherals

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Lego Logo unit	4.55
2.5	Use computer in school foyer to advertise PTA meetings, etc.	4.09
2.5	Assemble and program a small commercial robot	4.09
4.	Use computers to recite student poetry	3.36
5.	Develop conversation between two speech synthesizers	2.82

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROGRAMMING

4. Programming Tutorials/Problem-Solving Software

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Logic software	4.00
2.	Simulation software for finance lesson	3.64
3.	Students use basic task cards	2.73
4.	Use BASIC editing functions with poetry	2.27

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROGRAMMING

5. Top Down Programming

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Lesson sequencing/following directions	4.27
2.5	Complete a project in steps, procedures with sub procedures	3.82
2.5	Flowcharting activities	3.82
4.	Testing and debugging a program	3.64
5.	Writing style activity	3.27

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

PART B (continued)

PROGRAMMING

6. Using Algorithms for Solving Problems

Below is a ranked listing of curriculum integration activities that you and your colleagues evaluated based upon how you felt the activities supported the specific topic. Since the activities were ranked on a 5 point continuum ranging from low support (1) to high support (5), the activities with the highest group averages provide the strongest support for this specific topic.

Please examine these rankings. If you feel that some of the activities should be ranked significantly higher or lower, list the activities in the space provided and indicate the ranks you feel they deserve.

Rank No.	Topic	Group Average
1.	Have students give and take instructions	4.27
2.	Use logic and problem solving software	4.18
3.5	Make a flowchart to solve a specific problem	3.82
3.5	Design a simple program, then modify it to provide same outcome	3.82
5.	Program a speech synthesizer to give sequential instructions	3.09
6.	Use graphics pad to practice drawing flowchart symbols	1.82

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

Rank No. _____ should be changed to Rank No. _____.
Reason for ranking change.

(If necessary, use back of page for additional changes.)

Further comments that reflect your opinion:

APPENDIX D

COMPUTER INTEGRATION MODEL FOR LABORATORY COMPUTING TEACHERS IN THE ELEMENTARY SCHOOL

COMPUTER INTEGRATION MODEL FOR LABORATORY COMPUTING TEACHERS IN THE ELEMENTARY SCHOOL

Joan F. Junger

May 1988

This COMPUTER INTEGRATION MODEL for laboratory computing teachers in the elementary school consists of five computing content areas. For each area, topics of instruction and curriculum integration activities that support the teaching of each topic are listed. The topics and activities are listed according to how they best support the particular content area or topic. Care should be taken to choose and develop the ones that most appropriately correlate with the instruction for your specific grade level. These activities are designed for use and integration into the traditional elementary curriculum areas of language arts, mathematics, science and social studies.

COMPUTING CONTENT AREAS WITH THEIR RELATED TOPICS

APPLICATIONS/TOOLS

Word Processing
Databases
Telecommunications
Graph/Animation/Chart/Printing/Survey Tool/
Utility Packages
Electronic Spreadsheets
Peripheral Tools
Programming

COMPUTER OPERATIONS/KEYBOARDING

Proper Keyboarding
Disk Handling
Develop Speed and Accuracy
System Components (Hardware)
Vocabulary Development
Operating System Commands
Use of Software Documentation

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY

Communications/Telecommunications
Copyright Laws/Computer Crime/Privacy
Computers in the Workplace
Computers in Our Future
Equity in Computer Usage
Computers and the Handicapped
History of Technology

PROBLEM SOLVING

Hypotheses Development/Alternate Solutions
Group Cooperations Skills
Computer Applications as Tools for Solving Problems (i.e.
databases/spreadsheets)
Problem Solving Software
Brainstorming
Programming

PROGRAMMING

Languages (BASIC, Logo)
Programming of Speech Synthesizers, Robots
and Other Peripherals
Program Documentation/Error Tracking/Editing
Using Algorithms for Solving Problems
Top Down Programming
Programming Tutorials/Problem Solving Software

APPLICATIONS/TOOLS

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Word Processing	Writing process unit (concepts) Creative writing activity Journalism/newspaper unit Classroom newsletter Write research reports Poetry unit Keyboarding practice activities Parts of speech unit
Databases	Study of community/state Global geographical study and classification of countries Gather, sort and process information for projects and reports Study of dinosaurs Animal classifications unit Preparing student polls Record weather information Planetary studies Rocks/minerals classifications unit Research of the states Develop student identification list Categorize book reviews, reports Study Presidential bibliographies Politics unit Mapping skills
Telecommunications	Compare cultures with pen pals Develop research/library skills Electronic mail communications Create journal/diary

APPLICATIONS/TOOLS continued

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Graph/Animation/Chart/Printing/ Survey Tool/Utility Packages	Development of timeline activities Chart the population of countries Illustration of reports and projects Teach scientific observation/measurement and hypothesis Graph calendar and/or weather information Make math (or other content area) slide show with graphs Use with traditional art activities Chart distribution of different colors M&M's in a package Animation activities Create signs and advertisements Plot modes of transportation to school Calculate distribution of parents' occupations Chart the number of manned space flights per year Language analysis using parts of speech
Electronic Spreadsheets	Keep records for school club and/or make-believe business Unit on problem solving with estimation/calculations skills Study of math formulas/story problems Study of banking and currency Unit on decimals and percents Financial or numeric data collection
Peripheral Tools	Use touch window technologies in any content area Use joystick/mouse devices with simulation activites Use self-contained keyboard synthesizers Use graphics tablets to make pictures and signs Communicate conversations through synthesizers interfaced with micros
Programming	Use LogoWriter to develop/illustrate language story Study algorithms of simple mathematics formulas Create math story problems Vocabulary unit on programming concepts/fundamentals

COMPUTER OPERATIONS/KEYBOARDING

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Proper Keyboarding	Unit on keyboarding Revision process lessons Skill development toward the development of writing skills Use copy of a practice keyboard Use language development software Discuss topic poster Spelling, reading or handwriting lesson P.E. activities that develop good body positioning Use regular handwriting lesson to develop finger strength
Disk Handling	Lesson appropriate use of software Diskette preparation for information storage Dissect a disk to demonstrate its parts Unit on magnetics and the impact on diskettes Study how information is placed on diskette Write letters to a diskette manufacturer to get information and trends about diskette use
Develop Speed and Accuracy	Use typing tutorials/software Typing practice exercises Focus a lesson on occupations that require employees to consistently use keyboarding skills Invite school secretary to speak about keyboarding and importance of computers in the office
Systems Components (Hardware)	Identification/care of components Simulation activities illustrating input/process/output Reading/spelling activities Study computer mathematical functions

COMPUTER OPERATIONS/KEYBOARDING continued

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Vocabulary Development	Student-generated glossary/pictionary Science technology unit Activity focusing on contextual use of words Match work with definition Use game-type formats to develop skills Crossword puzzle Spelling unit
Operating System Commands	Conduct computer work session (save, load, delete from disk) Practice copying a public domain disk Read/discuss children's book on computer operations Program debugging activities
Use of Software Documentation	Lesson on following directions Reference skills Reading comprehension skills

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY
(Career/Past, Present, Future Technologies/Social-Ethical Issues)

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Communications/Telecommunications	Modem and cable TV use Develop class story books Create a student newspaper Use of computerized card catalog in a library Biography writing unit on famous people Science fiction story writing Study the history of the American expansion
Copyright Laws/Computer Crime/Privacy	Discussion of copyright laws as related to all content areas Role play classroom lesson on illegal copying of software Legal/social implications on use of large databases (i.e. social security/drivers license bureau) Discuss use of modems for data transfer Write essay about misuses of computer data Communications/journalism unit Values clarification activity Unit on U.S./local government Unit on criminal justice system
Computers in the Workplace	Study of technology uses in the community Interview speaker from technology professionals Write a report on computer careers Banking unit Unit on transportation Inventions/inventors unit Discuss calculators and "manual vs. mechanical" issues Computers in the entertainment industry Password game to identify occupations Design and print pictures of computer use in business Match job titles with descriptions Compare various computer companies by size, structure and products Unit on forecasting financial situations

COMPUTERS AND THEIR ROLE IN A TECHNOLOGICAL SOCIETY continued

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Computers in Our Future	Read stories and brainstorm Unit on the "house of the future" Unit on robotics Studies on space travel and astronomy Science fiction unit Use graphics software to design the structure of a house of the future Artificial intelligence unit
Equity in Computer Usage	Survey of student usage of computers in the school Survey of student preferences in software Compare and contrast cultural differences Study effects of employment Study of women and/or minorities in the workplace
Computers and the Handicapped	Watch a videotape illustrating new technologies Invite guest speaker to classroom Study of community helpers Health unit on special needs of the handicapped Discuss related articles, books, movies
History of Technology	Develop a timeline or wall chart of the generations of computers Invite a guest speaker from the community Compare trends in computing to agricultural and industrial development Create database using informations on the generations of computers Unit on mainframes, minis, micros Biographical studies of key people in the development of technology

PROBLEM SOLVING

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Hypotheses Development/Alternate Solutions	Laboratory experiments/investigations Biology/botany (plant growth unit) Using logic in math activities Unit on logic discrimination and strategies Unit on Presidential elections Nutrition study unit
Group Cooperation Skills	Write a group-generated story Student store simulation Model construction Plan an alternate bus route schedule Design a space station Develop a balanced nutrition/exercise program for class Study mapping skills
Computer Applications as Tools for Solving Problems (i.e. databases/spreadsheets)	Use a database to locate information to answer questions Use a database to make hypotheses and predictions Use a spreadsheet to make estimations Use spreadsheets to study patterns Use a modem to communicate with another school Use spreadsheets to ask "what if"
Problem Solving Software	Use programs that develop logic and memory Exploring situational simulation programs Word problems Gaming strategies Writing activities to develop different styles Reading/decoding messages Geography/mapping lessons Hierarchy of operations Coordinate graphing activity Apply/practice metric measures

PROBLEM SOLVING continued

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Brainstorming	Prewriting lessons Development of group techniques Simulation of historical decision Student composition of math word problem
Programming	Develop sequencing skills, logical processes Logo unit on shapes Modify a problem solution to different situations Define a problem Design a problem solution Evaluate and adjust problem solutions Design a flow chart

PROGRAMMING

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Languages (BASIC, Logo)	Use of Logo in simple geometry Write an illustrated, interactive story with sprites (LogoWriter) Write Logo/BASIC program Text/graphics illustrations lesson Use and vocabulary of programming Develop seasonal graphics programs Write program for calculating averages Invite a programming engineer to speak to the class Write poetry using programming techniques Calculation activities
Programming of Speech Synthesizers, Robots and Other Peripherals	Lego Logo unit Use computer in school foyer to advertise PTA meetings, etc. Assemble and program a small commercial robot Use computers to recite student poetry Develop conversation between two speech synthesizers
Program Documentation/Error Tracking/Editing	Editing and revising writing activities Develop scavenger hunt type activity using documentation Trace a program to find logic errors Word problems Experiment reporting Quiz students on various computer functions and have them find solutions in the documentation

PROGRAMMING continued

TOPIC	CURRICULUM INTEGRATION ACTIVITY
Using Algorithms for Solving Problems	Have students give and take instructions Use logic and problem solving software Make a flowchart to solve a specific problem Design a simple program, then modify it to provide same outcome Program a speech synthesizer to give sequential instructions Use graphics pad to practice drawing flowchart symbols
Top Down Programming	Lesson sequencing/following directions Complete a project in steps, procedures with sub procedures Flowcharting activities Testing and debugging a program Writing style activity
Programming Tutorials/Problem Solving Software	Logic software Simulation software for finance lesson Students use basic task cards Use BASIC editing functions with poetry

VITA

Joan Francene Junger

Candidate for the Degree of

Doctor of Education

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