DOCUMENT RESUME

ED 278 486 PS 016 285

AUTHOR	Hinitz, Blythe F.; And Others
TITLE	An Assessment of Children's Responses to Original Computer Readiness Activities.
PUB DATE	Nov 86
NOTE	28p.; Paper presented at the Annual Convention of the National Association for the Education of Young Children (Washington, DC, November 13-16, 1986).
PUB TYPE	Reports - Research/Technical (143) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Computer Uses in Education; Early Childhood Education; *Games; Instructional Design; *Kindergarten Children; Microcomputers; *Preschool Children; Pretests Posttests; *Readiness
IDENTIFIERS	*Project Head Start

ABSTRACT

This 3-year research project was initiated to demonstrate gaming as a methodology for developing young children's readiness skills for interacting with computers, and to investigate the feasibility of doing research in regular classroom settings. The first year was devoted to designing, making, and refining instructional materials. During the second year, one Head Start and two kindergarten classes participated as experimental and control groups. In the third year, the number of Head Start and kindergarten experimental and control groups was increased. Experimental group classes experienced an initial instructional unit in which functions of various computer parts, games, songs, and activities were taught. Subsequently, both experimental and control classes used computers. Data were collected on pre-tests and post-tests. Generally, results showed that the initial instructional unit helped the kindergarten experimental class children to remember the largest number of computer-related terms. The initial instructional phase also helped the Head Start children remember as many of the terms as children in the kindergarten control classes who were about one year older, and in some cases more. It is concluded that gaming is an effective technique for preparing children to use computers. Thirty-one references are provided. (RH)

AN ASSESSMENT OF CHILDREN'S RESPONSES TO ORIGINAL COMPUTER READINESS ACTIVITIES

BLYTHE F. HINITZ, Ed.D.
HARLENE L. GALEN, Ed.D.
HERMAN J. HINITZ, Ph.D.

November, 1986

Presented at the Annual Conference of the National Association for the Education of Young Children, Washington, D.C.

Abstract:

The numbers of computers in classrooms at all levels increase daily. For this reason, a project which encourages the learning of computer readiness skills by young children is valuable for their current and future cognitive and affective development. While most early childhood educators agree that microcomputers should be used by children, only a small percentage feel competent to help them do so. This research project assisted teachers, college students and children. By providing knowledge of computer related curriculum materials and computer programs appropriate for young children, it aided both teachers with computer skills and those who have yet to develop these skills. It helped college students in developing their skills through practical experiences in nursery school and kindergarten classrooms. It supported children in developing physical, affective and cognitive skills through gaming, both on the computer and with experimenter developed materials.

This project was initiated to demonstrate gaming as a methodology for developing young children's readiness skills for interacting with computers. Theoretical knowledge from Gotkin's work in Transactional Instructional Games, which combine programmed learning with verbal-social learning of the children, was utilized. Through taking part in various games, children were helped to transfer control of learning situations from adults to themselves. Thus, the children developed an independent learning style necessary for their use of computers in learning activities.

In the project, inexpensive alternative materials and

methods for teaching/learning computer related skills were developed. Some of the materials may be used in the classroom prior to accessibility to a computer. The material to be learned, in the games and computer programs, is broken down into small steps to enable students and teachers to progress slowly through a hierarchy of stages.

AN ASSESSMENT OF CHILDREN'S RESPONSES
TO ORIGINAL COMPUTER READINESS ACTIVITIES

HINITZ/ GALEN/ HINITZ

(Blythe Hinitz) Several theorists' work served as the basis for our research. Benjamin Bloom's studies suggested that half the variation in later intelligence is evident by the age of four. His work influenced our selection of subjects, ages 4, 5, and 6. Although we also used the Galen-Hinitz and the Hinitz-Galen matrix boards with three-year-olds during the first two years of our study, these children's demonstrated lack of developmental readiness convinced us to limit their computer related experiences.

J. McVickar Hunt identified the "problem of the match". He explained that activities prepared for children should be difficult enough to require attention and effort, but not so difficult as to be impossible. The adult's task in solving the problem of the match is to generate challenging activities which will not be too easy or too difficult, but "just right". Then, according to Hunt, the child will gain intrinsic satisfaction with no need for external praise or cajoling. Piaget's theory tells us that a valid match can be made between the child's cognitive structures and the available educational possibilities. Guided by this rationale, we created a variety of games and activities to meet the needs of children from different cultural, ethnic and socioeconomic backgrounds. The children in this study were in Piaget's pre-operational stage of development. This meant that they were, for the most part, egocentric. As expected, when dealing with the rules of the games we had created, the subjects often were incapable of considering both their own and others' needs and wants. Sometimes this resulted in their failure to abide by the rules.

O.K. Moore (Pines, 1967) and Lasar Gotkin worked in the field of programmed instruction. Moore developed the "talking typewriter" (Edison Responsive Environment) which allowed children to solve problems presented either on a monitor screen or by an audio tape played through a speaker. Moore believed that children are capable of great feats of inductive reasoning when they are left to themselves in a properly responsive environment. His booth contained a monitor, keyboard and microphone. All the components could be programmed to allow the child to teach herself skills in her own way without adult interference. The work with the talking typewriter in such places as the Drexel University Early Childhood Center (Baker, 1980) formed the foundation for current research in early childhood computer education. (Hinitz & Hinitz, 1986, July).

Gotkin's Interdependent Learning Model emphasized the transfer of control of the learning situation from the adult to the children. Learning took place in small groups which became increasingly less dependent upon the teacher and more interdependent. Gotkin's model evolved as a synthesis between programmed instruction and the verbal/social approach to learning. An important part of this model is the Transactional Instructional Games. The original transactional instructional games were broken down into sufficiently small steps so they were easy for the children to master. In addition, they required players' active physical and verbal involvement. The games gradually increased in complexity and provided information about both the cognitive and affective needs of the children. Gotkin's method of feedback, which we utilized in developing our own games, emphasized the use of positive instead of negative correction methods. (Galen, Hinitz, & Hinitz, 1985, November; Hinitz, Galen, & Hinitz, 1984, November). Gotkin's model stressed that once the children had internalized a game's rules, they could be encouraged to teach the game to classmates. We adopted this emphasis on peer teaching in our study.

(Harlene Galen) We conceived the study as covering a three year time span. The first year was to be devoted mainly to designing and making instructional materials, piloting them with children, and noting and making necessary modifications and adjustments. Data collection was to be accomplished during the second and third years. We realized that some additional modifications of the project and materials, based on input from teachers, college students, parents, and our own observations would take place after the second year; but we felt that these would be minor. Our predictions proved to be accurate.

The two main purposes of this study were:

1. To emphasize gaming as a mode for delivery of information to young children.
2. To examine the feasibility of doing research in non-laboratory, regular classroom settings.

We limited the delivery of information to the identification of and the understanding/knowledge of the main parts of the computer. Our rationale was that children needed this background in order to have meaningful experiences with computers.

We defined non-laboratory, regular classroom settings as: no choice of experimental subjects, no additional time to train the adults who participated, no paid personnel specifically for this project, no secretarial assistance, no outside funding, no specialized computer facilities (We utilized the elementary school and college computer laboratories), and no computer personnel. (We used college early childhood education students and kindergarten parent volunteers). Emphasis throughout the project was on meeting the objectives of existing Head Start and kindergarten curricula. Also, administrative support from the School District's Superintendent and Board of Education, and the College Dean and Committees had to be sought and maintained.

During 1984-85, the second year of the study, 1 Head Start and 2 kindergarten classes took part. The Head Start and one of the kindergarten classes participated in an initial classroom phase containing a unit about the functions of various computer parts, games, songs, and activities. The second kindergarten class, the control group, did not participate in the initial classroom phase. In 1985-86, the third year of the study, the number of experimental groups was increased--1 Head Start class and 2 kindergarten classes--. The number of kindergarten control groups was increased to 2 classes. Throughout both the second and third years, all classes participated in the second phase, "hands-on" use of computers.

Data collection consisted of a pre-test, post-test, post-test design. (See Levy, Schaefer & Phelps, 1986, for a discussion of pre-test/ post-test design) Administered at all three settings was the same experimenter-designed test. The pre-test was given to all children in experimental and control groups before they had experience with any of the project materials. The first post-test was given at the conclusion of the initial classroom phase (November '84 and October '85). The second post-test followed children's participation in the second "hands-on" computer phase (May '85 and May '86). Herman Hinitz will share the data with you when he subsequently reports on the statistics. I will report on a few of the common inherent challenges of doing research in non-laboratory, regular classroom settings. (See Almy, 1986, P.1, for a discussion of the current realities and future possibilities of this type of research).

1. Based on the second year's pre-test and post-test responses, we discovered that children gave more clear answers if their first incorrect response to the question, "What is this?" were followed by the question, "What part is this?" Therefore, we implemented this alteration for the third year's data collection. Much to our consternation, we discovered that only the early childhood undergraduates and Blythe, who administered the Head Start testing, followed the directions. The parent volunteers and teachers who administered the kindergarten testing did not ask the second question when a child gave an incorrect initial response, or a response of "Computer".

2. Absenteeism, especially during an outbreak of chicken-pox in the kindergarten during the third year, led to an unevenness in exposure to computer games for students. All computer-related activities were led by the principal and third grade students whom she had trained. Because these students could only be released from their own studies at specific times, kindergartners who were absent when the third graders worked in the kindergarten never were exposed to some of the computer related games.

(Blythe Hinitz)

We will now share with you a group of slides taken throughout the three years of the study.

Slide 1	During the first year of the project we focused mainly on introducing the children to
Slides 2-6	work with matrices. We began with the Gotkin boards. These show college student volunteers introducing the boards to and working with Head Start children.
Slide 7	We then moved the children to the Galen-Hinitz boards, one of which you see pictured
Slides 8 - 13	here. The boards were used with both Head Start and kindergarten children in the same ways as
Slides 14 - 23	the original boards. Here you see kindergarten children playing matrix games in the principal's office.
Slide 24 - 25	We found, after receiving the critiques from the adults involved, that changes were necessary.
Slides 26	In the second year, we simplified our matrix boards, reducing them from 4 to 3 columns, as shown here. This element of the Hinitz-Galen Boards eliminated the confusion children had regarding which was a middle-sized picture. We also created several card games, the most
Slides 27 - 30	popular among them being "Go Computer" and
Slide 31	"Computer Concentration".

Slide 31 cont.

We developed a song, mock disk drives and disks, and a mini-unit for introducing the terminology to the children. We asked the children to create original stories about caricatures and cartoons of computers. These were audio taped.

The physical development of the children was emphasized in four of our games: "Playing

Slide 32

Turtle", and "Computer Word Syllable Jump", developed during the second year; the

Slide 33

"Computer Circle Game", which was developed for the third year of the project; and

Slide 34

"Computer Twister" for the kindergarten classes, which utilized a floor keyboard sold by Scholastic.

Slides 35 - 47

We began the pre- post-test format, which consisted of one pre-test before the children had experience with any of the project materials; a first post-test which was administered after the terms had been introduced via the mini-unit, the matrix boards and the card games, and prior to any hands on computer experiences (Nov'84 & '85); and a second post-test (in May'85 & '86) after two of our three/ three of our five groups had used the games, and all the children had hands on experiences with a computer. In the third year, we discarded some games, and added a new circle-song game and a new card game. We de-emphasized the matrix. We re-wrote the mini-unit to highlight the similarities between the functions performed by people and computers.

We'd like to share with you an example of one way we modified the materials based on the data we collected from the second year of the project. When we analyzed the second post test, we discovered that many of the children were giving the names of other things for computer parts, for example vacuum, and radio. We decided that we had not given the children enough practice in categorizing elements which were computer-related and elements which were not computer-related. We then utilized principles from programmed instruction and the Montessori method in

Slide 48

designing the Computer-Not Computer game. Basically, what the child is asked to do is identify drawings of familiar objects and computer parts and sort them into two general categories, those which are parts of the computer and those which are not. Only after the child has completed the sort and checked the back of the cards for accuracy of categorization, is that child asked to name the pictures within each category.

Slide 49

We were fortunate in having access to the college and elementary school computer labs. In addition, the kindergarten children had

Slides 50 - 65

computers in their classrooms. Some of the interactions which took place in the college computer laboratory during the second and third years of the project are shown in these pictures.

For further discussion of our work see the articles and ERIC documents cited in the bibliography.

(Herman Hinitz) In general, the results of the pre/post tests showed that the initial instructional unit, games, songs, and activities helped the kindergarten experimental class children to remember the largest number of these 10 terms: monitor, keyboard, central processing unit (CPU), disk drive, disk, tape recorder, tape or tape cassette, printer, mouse, and joystick.

This initial instructional phase, in general, helped the Head Start children to remember as many as, or in some cases, more of these ten terms, than the kindergarten control class children, who were about one year older. The children who benefitted the most were the ones who were interested in the initial classroom instructional unit, games, and activities as well as in the later hands-on phase. In some of these cases, there appeared to be a very beneficial interaction between the information from the initial instructional phase, and the practical experience in the later hands-on phase.

Before studying Tables 1 - 5, please remember that the conditions in the classrooms in this study were of the type encountered in normal school settings. No effort was made to change the classroom situations into carefully controlled laboratory conditions. Each class was dealt with on an "as is" basis, with minimal modification of the normal activities. The computer was regarded as a natural part of the environment.

INSERT TABLES 1,2,3,4,5, ABOUT HERE

Table 1. Tests and Measurements.

Three tests (one pretest, a first post test, and a second post test) were given, in which children were asked to name the ten computer parts. Their exact responses were recorded on a mimeographed form. Each response was given a numerical value, based on how much the children remembered of the names and/or the ways that the parts functioned or operated.

Scores for responses on pre- and post tests:

4: exactly completely correct response given by child

3: very closely related response or explanation (typewriter instead of printer)

2: computer related response is partially correct (game stick instead of joystick)

1: non-computer related response is remotely correct, and related to prior experiences (vacuum cleaner instead of mouse)

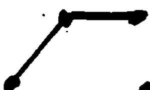
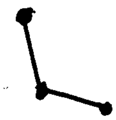
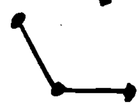
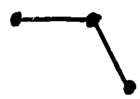
0: totally incorrect responses or no responses

Two separate total scores were obtained for each of the three tests for each child. One total score, Type 1, added only the values obtained for the completely correct responses, and ignored any partially correct information. The other total score, Type 2 was obtained by adding all values, both from the completely correct, as well as from the partially correct responses.

For example, if a child's responses were: keyboard, typewriter, and game stick, the Type 1 score would be 4, because there is only one completely correct resonse, keyboard. The Type 2 score of 9, is obtained by adding 4 for the keyboard, 3 for the typewriter, and 2 for the game stick.

Table 2. Information Retention Patterns

In these classes, there were nine possible types of patterns, A through I, over the course of the year, with the possible changes that could occur in the amount of information that the children remembered, between each of the tests.

Test:		1	2	3
	A:	increase,	increase	
	B:	increase,	decrease	
	C:	increase,	no change	
	D:	no change,	increase	
	E:	decrease,	decrease	
	F:	decrease,	increase	
	G:	decrease,	no change	
	H:	no change,	decrease	
	I:	no change,	no change	

Type A: provides for a continual improvement by the reinforcement of the initial classroom instruction by the hands on experience with the hardware and the achievement or goal oriented software

Type B: improvement during classroom phase but little or no benefit from hands on experience

Type C: similar to Type B

Type D: little or no apparent benefit from classroom instructional phase, but did show improvement from hands on phase

Type E: little or no benefit from instructional and hands on phases, opposite to Type A

Type F: similar to Type D, opposite to Type B, little or no apparent benefit from classroom instructional phase, but did show improvement from hands on phase

Type G: similar to Type E, opposite to Type C

Type H: similar to Type E, opposite to Type D

Type I: little or no benefit from instructional and hands on phases

Table 3. Average percent values, for the sums of the scores, for all three tests, of all students in each of the three classes, showing Type 1 and Type 2 test responses, for pattern categories A through I, being tested for the pretest, and both of the post tests. The Headstart (HD) class had 14 students in the second year, and 8 in the third year. The Kindergarten Experimental (KE) class had 20 students in the second year, while in the third year, there were 18 and 17 students, respectively, in the Kindergarten Experimental A and B classes (KE A and KE B). The Kindergarten Control (KC) class had 19 students in the second year, while in the third year, there were 14 and 13 students, respectively, in the Kindergarten Control A and B classes (KC A and KC B).

Class	HD		KE			KC		
Year of Study	2nd	3rd	2nd	3rd A	3rd B	2nd	3rd A	3rd B
TYPE 1	27	32	32	50	48	27	29	24
TYPE 2	49	67	53	72	76	43	65	61

Table 4. Highest percent score value achieved by any student, in each class, only on the third test, at the end of the second year, and at the end of the third year.

Class	HD		KE			KC		
Year of Study	2nd	3rd	2nd	3rd A	3rd B	2nd	3rd A	3rd B
TYPE 1	60	50	90	100	90	60	70	50
TYPE 2	80	80	98	100	98	85	85	65

Table 5. Average percent values for the sums of the scores, for all three tests, of students showing Type 1, and Type 2 test responses, according to pattern categories A, B, D, and F, who were being tested with all three tests. The values in the parentheses indicate the percentage of the number of students, that were in those particular categories, out of all of the students in that class. The Headstart (HD) class had 14 students in the second year, and 8 in the third year. The Kindergarten Experimental (KE) class had 20 students in the second year, while in the third year, there were 18 and 17 students, respectively, in the Kindergarten Experimental A and B classes (KE A and KE B). The Kindergarten Control (KC) class had 19 students in the second year, while in the third year, there were 14 and 13 students, respectively, in the Kindergarten Control A and B classes (KC A and KC B).

Class	HD		KE			KC		
Year of Study	2nd	3rd	2nd	3rd A	3rd B	2nd	3rd A	3rd B
Category	TYPE 1							
A	32 (29)	27 (13)	36 (45)	45 (72)	43 (82)	29 (79)	25 (36)	27 (15)
B	29 (21)	33 (25)	31 (35)	--	--	--	--	30 (8)
D	13 (7)	17 (25)	--	20 (6)	--	18 (16)	24 (21)	20 (15)
F	--	--	--	--	17 (6)	--	26 (21)	18 (15)
	TYPE 2							
A	59 (21)	61 (50)	59 (45)	67 (50)	66 (59)	48 (37)	58 (14)	51 (15)
B	49 (50)	--	48 (40)	60 (11)	56 (12)	--	53 (36)	51 (54)
D	43 (7)	45 (25)	46 (10)	40 (6)	--	57 (5)	--	--
F	53 (7)	48 (13)	40 (5)	53 (22)	59 (29)	38 (58)	56 (14)	48 (15)

In tables 3, 4, and 5 are the results of the second and third years of the study. Overall, the third year results appear similar to those of the second year. Compared with the second year children's responses, the third year children's incorrect answers on the second post test included more computer-related terms than non-computer terms. This finding suggests that even though the children were unable to completely and accurately identify all the specific computer components correctly, they were able to differentiate between what items belonged with the computer and what items did not. Please note that Table 3 refers to the average percent values for the sums of the scores, for all three tests, of all students in each of the three classes, showing Type 1 and Type 2 test responses, for categories A through I on the pretest, and both of the post tests. Table 5 is an expansion of Table 3, but is limited to the four pattern categories which appear to be the most significant to examine.

As indicated in Table 1, each response was given a numerical value, based on how much the children remembered of the names and/or the ways that the parts functioned or operated. Two separate scores, TYPE 1 and TYPE 2, were obtained for each of the three tests for each child. The TYPE 1 score added only the values obtained for the completely correct responses and ignored any partially correct information. The TYPE 2 score was obtained by adding all values, both from the completely correct and the partially correct responses. For example, if a child's responses were: keyboard, typewriter, and game stick, the TYPE 1 score would be 4, because there is only one completely correct response - keyboard. The TYPE 2 score of 9 is obtained by adding 4 for the keyboard, 3 for the typewriter, and 2 for the game stick, as in Table 1.

In Table 2, for the TYPE A pattern, for example, there was an increase in the test scores between tests 1 & 2, and another increase between tests 2 & 3. This pattern appears to show a continual improvement, because of the re-enforcement of the initial classroom instruction by the subsequent hands-on experience with the hardware and software.

We observed nine possible types of learning progression patterns, A - I, as described in Table 2. These patterns represent the possible changes that could occur in the amount of information children remembered between the first and second tests and between the second and third tests in all the classes in the study. The <u>amount</u> of the increase was <u>not</u> considered, only the overall <u>pattern</u>.

The test values for the kindergarten experimental class were, in general, the highest among the three types of classes. These children appear to have been able to make the most use of the computer related information provided during the entire year. In the third year, the TABLE 5 results for the kindergarten experimental classes improved from 36% (for 45% of the children) up to an average score of 44% (for 77% of the class) in the TYPE 1 scores for the TYPE A pattern. There was an improvement in the TYPE 2 scores for these children, from 59% (for 45% of the class) up to an average score of 67% (for 55% of the children).

The kindergarten control classes in the third year had about the same TYPE 1, and slightly higher TYPE 2 results, when compared with the scores obtained in the second year. But, the number of these children showing a TYPE A pattern decreased, in the third year, when compared with the values in TABLE 5.

The Head Start class test values were, in general, approximately equal to, or higher than, the values obtained for the kindergarten control class, in both the second and third years. The children in the Head Start class were about one year younger than the children in the kindergarten control class.

A difference of one year is not too significant for adults, but is significant for children of 4, 5, and 6 years. The preparatory classroom instructional phase appears to have provided advantages to the Head Start and Kindergarten Experimental children. These skills do not seem to be attainable in this time frame when the experience provided with the computer is limited only to hands-on exposure.

It appears from the test results, that what we did to help the children, WORKS!

(Harlene Galen) We will now share our implications and conclusions from this three-year study.

Implications:

1. College early childhood education students who are introduced to non-laboratory research may develop a sustained interest in such projects. At least four of Dr. Blythe Hinitz' students persevered through all three years of this study. Another was so interested after one year of participation, that she requested further involvement when she returned from exchange study in England.

2. Parents want the best for their children, and especially in the earlier grades, will support and assist in research which may help their children. During both the second and third years of this study, all kindergarteners' parents and all but one of the Head Start parents gave written permission for their children's inclusion in the study. Kindergarteners' parents who were asked to serve as volunteers in the classrooms to help with the pre- and post-testing readily accepted that responsibility.

3. Both in 1984-85 and 1985-86 teachers of the third grade pupils who played computer-related games with kindergarteners in the experimental groups reported that the third-graders became more knowledgable about computers. Kindergarteners, as related by their teachers, often responded better to this older peer instruction than to that of the volunteer parents. Mentioned by both third grade and kindergarten teachers were the positive attitudes of both the younger and older students. This conclusion corroborates research reported in <u>What Works, Research About</u>

Teaching and Learning (1986). "Students tutoring other students can lead to improved academic achievement for both student and tutor, and to positive attitudes toward course work". (U.S. Department of Education, 1986, P. 36)

4. In-service teachers/administrators will recognize the value of parts of non-laboratory research which apply to their situations. We'd like to share three examples:

a. Frequently during workshops which we have given on this research, teachers in nursery schools or day care centers without computers have mentioned that the computer-related activities and games in the study were the answer to parents' request for children's exposure to computers. These resources were especially well-received in instances where money for computers would not be available for a long time.

b. Another illustration: one of the kindergarten teachers who had been involved in this three-year study asked, last June, if she would be permitted to continue post-testing her students on their knowledge of computer parts. She didn't feel that she had time to do the pre-testing but she opined, "I like knowing just how much my children have learned about the computer from 'hard data' rather than just from my observations".

c. Third example: Since the results of this study show that exposure to computer-related games and activities does make a difference in children's knowledge about computer parts and their functioning, the initial classroom phase has been adopted as part of the Edgewater Park, NJ kindergarten curricula for all classes, commencing with the 1986-87 school year, with the full support of the Superintendent and Board of Education.

Conclusions:

1. Gaming is a good technique for helping to prepare children for using the computer.

2. Gaming involves children actively. Therefore, they learn the terms/ concepts being taught and retain them when sitting in front of the computer and when tested.

3. The transactional instructional game methodology works well with young children.

4. Young children can learn computer terms, and facts from a variety of different teaching methods, including: group discussion, teacher presentation, movement games, objects in the dramatic play area (disks & disk drives),songs, drawing, looking at photos and pictures from magazines.

5. Young children can learn games with simple rules.

6. Readiness activities such as those we devised should be used prior to giving young children "hands-on" experiences with actual computers.

7. Games used as readiness activities can enhance children's use of computers.

BIBLIOGRAPHY

NAEYC November, 1986

Almy, M. (1986, March).The past, present, and future for the early childhood education researcher. Early Childhood Research Quarterly. 1 (1), 1-13.

Baker, L.B. (1982). A unique blending of technology and education using the self-controlled interactive learning systems (SCILS) in an ongoing early childhood program. In Nir-Janiv, Spodek & Steg. Early childhood education: An international perspective. NY: Plenum Press.

Bloom, B. (1964). Stability and change in human characteristics. New York: John Wiley & Sons.

Brady, E. H. and Hill, S. (1984, March). Young children and microcomputers: Research issues and directions. Young Children. 39 (3), 28-33.

Campbell, P.F., & Fein, G.G. (1986). Young children and microcomputers. Englewood Cliffs, NJ: Reston Books Division of Prentice Hall.

Durkin, L. (Ed.) (1986, October). Computer ease. [entire issue] First Teacher. 7 (10).

Forman, G. (1986, August). Observations of young children solving problems with computers and robots. Journal of Research in Childhood Education. 1 (2), 60-74.

Galen, H.L. & Hinitz, B.F. (1985, Fall). Computer-related games: Ready, set, go. Day Care and Early Education, 13,(1), 30-5.

Galen, H., Hinitz, B., & Hinitz, H. (1985, November 15). Developmental computer awareness: Responses of Head Start and kindergarten children. Paper presented at the Annual Conference of The National Association for the Education of Young Children, New Orleans, LA. (ERIC Document Reproduction Service No. ED 264 971)

Genishi,C., McCollum, P., Strand, E., & Hamilton, S. (1985, April 3). An observational study of young children and LOGO. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Goodwin, L.D., McCollum, P., Strand, E., & Hamilton, S. (1986, Fall). Cognitive and affective effects of various types of microcomputer use by preschoolers. American Educational Research Journal, 23 (3), 348-356.

Gotkin, L. G. (1967). Checklist for matrix games. NY: Meredith Publishing Company.

Gotkin, L.G. (no date). Games and other activities for developing language skills. NY: Institute for Developmental Studies, New York University. (ERIC Document Reproduction No. ED 022 555)

Gotkin, L.G. (1967). Instruction book for matrix games. NY: New Century, Educational Division, Meredith Corporation.

Gotkin, L.G. (1967). Programmed instruction as a strategy for developing curricula for children from disadvantaged backgrounds. NY: School of Education, New York University, 1967. (ERIC Document Reproduction Service No. ED 015 782)

Gotkin, L.G. (1967). Teacher's introduction to matrix games. NY: New Century - Educational division of Meredith Corporation.

Gotkin, L.G. & Wolff, D. (1969). Transactional instructional games: A definition by criteria. (A working paper - mimeographed). Edited by Linda Barry. NY: Institute for Developmental Studies, New York University.

Hinitz, B. (1985, May). Gaming - An innovative path to computer literacy in the laboratory early childhood center. National Organization of Child Development Laboratory Schools News, Bulletin No. 4.

Hinitz, B., Galen, H. & Hinitz, H. (1984, November). Matrix games: An innovative path to computer literacy. Paper presented at the Annual Conference of The National Association for the Education of Young Children, Los Angeles, CA. (ERIC Document Reproduction Service No. ED 252 314)

Hinitz, B., & Hinitz, H. (1986, July). Innovations in computer education for young children in the U.S.A.: A report of research. Paper presented at the Association for Childhood International Conference, London, England.

Hinitz, B., Hinitz, H., & Galen, H. (1986, July). Gaming and technology - Implications of research for young children worldwide. Paper presented at the XVIII World Congress of the World Organization for Early Childhood Education, Jerusalem, Israel.

Hoover, J.M. & Berghout Austin, A.M. (1986, April). A comparison of traditional preschool and computer play from a social/cognitive perspective. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Hunt, J.M. (1961). Intelligence and experience. New York: The Ronald Press.

Ilan, Shmueli, Blitz & Shlezinger. (1986, July). GTM pre-school computer use for concept learning. Paper presented at the XVIII World Congress of OMEP, Jerusalem, Israel.

Klinzing, D. G. (1985, March). A study of the behavior of children in a preschool equipped with computers. Paper presented at the Computers and Young Children Conference, Newark, DE.

Levy, A.K., Schaefer, L., & Phelps, P.C. (1986, June). Increasing preschool effectiveness: Enhancing the language abilities of 3- and-4-year-old children through planned sociodramatic play. Early Childhood Research Quarterly, 1 (2), 133-153.

Paris, C. (1984, April 6). Integrating computers into a developmental preschool classroom (A Computer Active Preschool Project [CAPP]). Paper presented at the National Conference on Computers and Young Children. University of Delaware, Newark, Delaware.

Piaget, J. (1970).Science of eduation and the psychology of the child. (Trans.) New York: Orion Press.

Pines, M. (1967). The talking typewriter. In Pines, Revolution in learning: The years from birth to six. New York: Harper & Row.

Strand, E., Gilstad, B., McCollum, P., & Genishi, C. (1986, April). A descriptive study comparing preschool and kindergarten LOGO interaction. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

United States Department of Education. (1986). What works, research about teaching and learning. Washington, D.C.: Author.