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Kindergartners Perception of the Classroom Computer

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A Case Study

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ABSTRACT

Computers have an overwhelming influence in the school and home environment. Computers are available in many early childhood classrooms and young children have easy access to them. This case study examined the youngest members of the elementary school's perception of the classroom computer. A seven-week research study explored the role of the computer in a kindergarten classroom. Sixteen kindergartners were interviewed and observed. The children's perceptions of the computer were recorded through conversations, interactions with the computer, classroom observations and computer lab observations. Computer programs, computer integration and the role of the teacher were examined. Results from the interpretation of the data revealed that kindergarteners like learning and playing on the computers and that appropriate use of the computers contributes to the kindergarteners social/emotional and cognitive development. The classroom teacher plays a pivotal role as the facilitator and integrator of computer technology. The research indicated that computers do enhance children's intellectual and social development as long as computer interactions are carefully introduced, monitored, and assimilated into the classroom.

INTRODUCTION

At 2:00 on a Monday afternoon nine kindergarteners and their teacher, Ms. Edwards, are gathered around the benches. In front of Ms. Edwards are three plastic boxes. Ms. Edwards hands one basket to three of the children. "You are holding the school year," she tells the children. She has a child put a basket in the middle of the benches. "That's what's left of kindergarten," Ms. Edwards says, referring to the one basket. "One third," a child says. Another child states, "One hundred and twenty days are gone," "How many are left?" Ms. Edwards asks. "Sixty days," the child replies.

Thus the day's math lesson has begun. Some of the children remain at the benches and count out two thirds of one hundred as they place glass gems on sixty-six squares of a numbered sheet. Some of the children begin making pattern block designs on the floor. The rest of the class follows Ms. Edwards over to the four classroom computers. As they walk Ms. Edwards reiterates that two thirds of the school year has already passed. A pattern block program (Shape Up) is visible on the computers. On one computer is a mirror program. The shape that a child makes on one half of the screen is immediately replicated on the other half of the

computer. On the next computer the child can take any geometric shape and double, triple, or quadruple it. An empty pattern block puzzle is on the screen of the third computer. The child can fill in the puzzle using a combination of pattern blocks. In the process the child is able to see that a hexagon is made up of two trapezoids (halves), three parallelograms (thirds), or six triangles (sixths). Mathematics is thoroughly integrated throughout the classroom environment and technology plays no small role.

Computers are quickly becoming a fixed feature in the elementary school classroom. Numerous studies have been conducted that examine the role of the computer in the PreK-2 classroom. There is much controversy about whether or not computers enhance or hinder a child's physical, emotional/social, or intellectual development. There is concern that computers are replacing other learning activities such as dramatic play or block play. The role of the classroom computer really intrigues me because I think that the computer is a fascinating, innovative learning tool. Yet I wonder if are we moving too quickly in our implementation of computer activities in the early childhood classroom. I think it is imperative that we address this question to the young children themselves. How do they perceive the computer? Do they see it as a form of play or as a learning tool? Through observation and interviews with PreK-2 children I hope to assess their views. In order to form any type of opinion or advocate for or against the PreK-2 classroom computer it is crucial to view the computer through the eyes of the child.

CONCEPTUAL FRAMEWORK

The availability of computers in the early childhood classroom has risen considerably in the last few years. Indeed ninety-nine percent of full-time regular public school teachers reported that they had access to computers or the Internet somewhere in their schools (US Department of Education, 1999). Computers are augmenting or replacing various classroom-learning activities in mathematics, science, and the language arts. Numerous research studies have been conducted, on

this topic, and many controversial issues have arisen. Some of the studies laud the classroom computer (Bergin, et al, 1993; Podmore, 1991; Seng, 1998; Talley, et al, 1997) and others denounce it (Miller & Cordes, 2000). Many studies have been conducted about this topic yet there have only been a few studies (Podmore, 1991 and Seng, 1998) that I have found that actually ask the children what they think. If teachers want to create a truly child-centered classroom, it is necessary that they find out how the children perceive the classroom computer. The purpose of this study is to explore students' perception of her/ his computer use.

For this study I will focus on the children who are just entering the public elementary schools: the kindergartners. How do these young students view the classroom computer? What does other research have to say about this? I found two studies that specifically focused on kindergarteners. Bergin, Ford & Hess (1993) studied the patterns of motivation and social behavior associated with microcomputers. Their research participants were 95 kindergartners (53 male and 42 female) and four teachers (all female) from four classrooms in three separate schools in the San Francisco Bay Area. These children, working together in pairs at microcomputers were observed over a four-month period. The children were rated monthly by both observers and videotape footage using a scale of 1-5 on their levels of cooperation and dominance and a scale of 1-4 on overall interest. The students displayed interested, engaged behavior throughout the four phases of the data collection. Children were on task, attending to either the computer or an observer teacher approximately 90% of the time, at each phase of the study. There was no difference in these schools in the levels of overall interest. The computer thus appeared to highly motivating instructional context for children in all four classrooms. This high level of interest did not diminish over time, as a novelty effect would have predicted (Bergin et al, 1993: p. 442).

Valerie Podmore (1991) studied the perceptions and social behaviors of 4-year-olds and 6-year-olds using microcomputers. Twenty-eight children (fourteen boys and fourteen girls; equally

divided, either 4 or 6 years olds) in a medium sized New Zealand city, were participants in this study. The study was divided into three main phases: pretreatment or baseline (the first term of the school year), post-treatment or computer–interactive (second and third term of the school year) and a final phase of software evaluation. During the pretreatment phase teachers began a computing course at Teachers College. All children were interviewed and baseline observations were made of the children. The post-treatment phase began with the introduction of microcomputers in the learning environment. The postcomputer observations of the children began and continued throughout the second term. At the end of third and final term the children completed the postcomputer interview (Podmore, 1991).

Podmore's research indicated that the majority of the children perceived computers as being fun both before and after using them. Only a very small number thought they were "no fun at all." These findings support the view that, for many but not all young children, computers are intrinsically motivating in the sense of providing pleasurable learning activities. Children as young as four years old were able to state which computer program they liked or disliked. For many of the children the computers were also motivating in terms of learner persistence and high task involvement. The 28 observed children did not appear to become socially isolated when a microcomputer was introduced to in their classrooms. They were generally unconcerned about who was using the computer with them, and they were usually cooperative while waiting for turns. These results tend to support other research that working computers can have a positive influence on young children's socialization (Podmore, 1991).

For the study I am conducting I too will observe the social patterns that surround the computers but my main focus will be on the kindergarteners perceptions of the computer itself. Podmore's data on children's perceptions of the computer was quite limited. She only looked at why the young children either liked or disliked the computer and how they perceived the computers

in terms of fun (ranging from quite a lot of fun to no fun at all). I want to know more about the child's perception of the computer. What do five and six year olds think they are learning at the computer? How does this compare with other learning centers in the room? Does the computer contribute to the student's social/emotional and intellectual growth? By interviewing the children directly and observing them at the computer I will be able to hypothesize about the kindergartners perceptions of the classroom computer.

My research articles are limited to those, which are available through the databases at the University of Massachusetts' Dubois Library [electronically and through research journals]. Though there may be additional studies about the role of the computer in the early childhood classroom I was only able to locate two studies that deal specifically with kindergarteners. This study is also limited to one particular kindergarten classroom. It does not represent all kindergarten students.

METHOD

I have chosen to conduct a qualitative case study of a specific kindergarten class that has access to classroom computers. I want to explore the kindergartners interactions with their classroom computer. My intention is to observe the children at the classroom computer and interview them about their views of the computer. My research approach is qualitative because I will be the key instrument in the data collection; the study will take place in the natural setting (the classroom); the data will be collected as words and pictures using expressive and persuasive language; the analysis of the data will focus on the participants view; and the outcome will be more of a process than a product. The tradition I will be employing is a case study since a specific case (the kindergarten classroom) bounded by time and place will be examined; multiple sources of data will be collected (interviews, field notes, video tapes, and various documents); and considerable time will be spent in the field. In this section I will describe the setting and participants; gaining

entry and informed consent; my personal profile as the researcher; data collection procedures; data analysis; and trustworthiness.

Setting and Participants

The setting of this case study is Sharon Edwards' kindergarten classroom at Mark's Meadow Elementary School in Amherst, MA. This class is composed of two teachers, Ms. Edwards, a paraprofessional and eighteen five and six-year-olds from diverse cultural and socioeconomic backgrounds. The teacher, Sharon Edwards, Ed.D, has been teaching at Mark's Meadow for over twenty years. She has taught first through third grade. This is her first year teaching kindergarten. I have selected this site for several reasons; most importantly the subjects that I need for my case study, PreK-2 students with classroom computer accessibility, are members of this classroom. There are four computers available in the classroom. Of the eighteen students three of the children are from Korea, four of the students are African American, and three of the students are of Hispanic dissent thus there is variability in the sampling. The school is in a convenient location and I know the teacher. Moreover I am also a parent of a student in the classroom and therefore already an "insider." I know many of the children and some of the parents. This will increase the possibility of obtaining signed permission slips from these parents so as to involve their children in this research.

Gaining Entry and Informed Consent

To gain entry into this site I approached Ms. Edwards in early February 2003 with my preliminary plans. She appeared to be quite interested in my research project and was very receptive to the idea of me observing her students at the classroom computers. We met soon afterwards to discuss my initial research proposal and the informed consent. She helped me edit both of these forms. The edited forms were then presented to the Mark's Meadow School principal. The principal

also expressed interest in this study and gave her approval. Two copies of the informed consent were then sent home with each of the kindergartners.

Researchers Profile

I am a mother, a wife, a graduate student, and a teacher. I have two children: a kindergartner and a sixth grader. My life is constantly shifting between these various roles, all of which are intertwined yet each with their own individual demands and rewards. In my various roles, I see the value of each individual's input. I think that everyone has something important to contribute and that we as teachers, partners, students, and parents need to listen closely to the voices of those around us. We need to watch for any signs of enthusiasm or discontent. We need to appreciate what others understand in order to help them make sense of their world. This is why I am interested in qualitative research. This research approach focuses on the participants' views, in their natural setting; and the researcher herself is the key instrument of data collection. I think this is vital, how can we find answers to issues concerning people without observing and interviewing the people themselves?

One of my great interests is technology. I have been attracted to technology ever since I got my first computer six years ago. Though the computer technology was completely foreign to me I immersed myself in learning all I could. I began taking various educational technology classes and learned how to design web sites, create charts with Excel, design slide shows with PowerPoint, and experiment with different types of software.

I wanted to integrate my fascination with computer technology in with my other roles. My son already knew more about computers than me, but my husband and daughter were as new to this technology as myself. I wanted to buy my children developmentally appropriate software but I wasn't sure about what to buy. I looked at various software programs available through my classes

and my children's school. I began to ponder the significance of a having a computer available to a young child. At first, I was particularly interested in whether or not early childhood educators were properly trained to appropriately utilize computers in their classrooms. Since I was working with student teachers I asked them about their computer training. I conducted a research study about computer training for early childhood educators for another class. In this study I neglected to look at the role of the child. How do they feel about the computer? The child's perception of the computer became my focal point and thus the focus of my qualitative research design.

Trustworthiness of the Data

A qualitative study can produce much descriptive detail about the setting, participants, artifacts, and the operation of a given situation. In this particular type of study however the researcher not only has a responsibility to describe setting in ways that it was lived by the participants, but also to inspire the readers trust in the accuracy of what is being portrayed (Graber 1991, p.43). Several strategies were employed to assess the trustworthiness of this data, they are triangulation: member checks, and peer debriefing.

Triangulation. Multiple sources of data were collected and a variety of methods were used. The researcher conducted videotaped interviews with all sixteen of the (permitted) children. The researcher transcribed all the videotaped interviews and field notes. She replayed the videotapes several times as she transcribed them and then reviewed the transcriptions for accuracy. The researcher revisited the interviews with the children while they were at the computers to assess their validity. The researcher observed the students at least three times a week in both the classroom and the computer room. The researcher collected drawings by the children. The researcher observed the classroom teacher as she integrated the computer programs in with other academic activities and as she introduced the kindergartners to the computer programs themselves. The researcher carefully

reviewed and photographed the software being used. She spent an extended period of time in the field, three days a week for seven weeks.

Member checks - The researcher conducted member checks in which she asked the children to reiterate some of their answers. She gave the children the opportunity to expand upon their answers or provide further clarification of what they meant. The researcher shared information gathered during the field notes and interviews with the classroom teacher to assess accuracy. She also asked the teacher to review the material for any discrepancies.

Peer Debriefing – The researcher met weekly with her critical friends to discuss issues of validity, trustworthiness, and ethics. This group of critical friends shared resources and reviewed each other transcriptions to ascertain whether their findings were relevant to the overall research questions. They discussed data analysis, interviewing techniques, and problems that arrived in their study.

Data Collection

For my data collection I used a purposive, non-probability sampling, which was both typical and convenient. Multiple forms of data collection were employed for this research project. The initial form of data collection was observation. To assure a certain comfort level with the children I conducted several preliminary observations as a participant observer in early March, gathering only hand written field notes. My observations took place during the month of March and the first three weeks of April 2003. I observed the kindergartners three times a week. I observed the children during direct math instruction and practice every Monday and Friday from 1:30-2:30, and for twenty minutes after this (2:30-2:50) in which they had free choice and could choose what they wanted to do. I also observed the children during direct instruction, practice and free choice in the computer room from 10:00 – 10:30 on Thursday mornings. I carefully listened and took notes as Ms. Edwards introduced the children to various computer programs. I asked the children brief

questions as they interacted with the computers during practice and free choice time. At the end March when I had received sixteen of the eighteen-signed consent forms I began to videotape and interview the kindergartners. The videotaped informal interviews consisted of focus groups of three children. In an attempt to look at the computer through the children's eyes the kindergartners were asked several more-and-less structured open-ended questions about their perceptions of the computer. I asked the participants twelve questions such as: What do you use the computer for? Do you want to be with someone or be alone while you're at the computer? Do you play or learn at the computer? How are these different? Do you wish you could spend more time or less time at the computer? Can you tell me what you like about using the computer? Can you tell me what you don't like? The interviews lasted approximately thirty minutes. The kindergartners were encouraged to draw pictures and explain their views using the computers. A follow up of the interviews were assessed individually through further individual observation.

Analysis of Data

The raw data as recorded and videotaped were transcribed verbatim for each interview and classroom and computer observation. The data collected during the interviews were compared with what was actually observed. Field notes and transcriptions were assessed to reveal any discrepancies between what was recorded during the interviews as opposed to that which was observed at the computers. Evidence of intellectual growth was pondered by analyzing what the children were actually learning (or not learning) at the computers. Analyzing kindergarteners interactions with each other while they were on the computers assessed evidence of social/emotional growth.

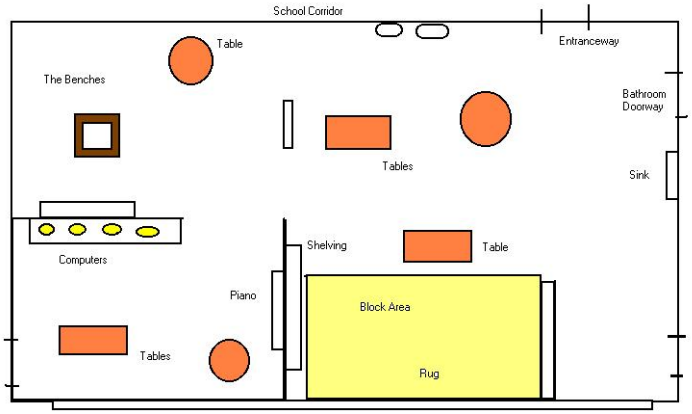
The transcriptions from the interviews were combined and grouped according to the specific questions. This data was then reduced and redundant information was paired together. Significant statements and common themes were extracted from this reduced data.

The children's drawings and photographs of their computer designs were printed out and placed in protective covers. Verbatim descriptions of the artwork and computer work were recorded and analyzed. Evidence of the students' perceptions of the computer were noticeable through their drawings of themselves on the computer and through the designs they had created on the computers.

Inductive coding then commenced with the field notes. First I openly coded the field notes looking for important concepts and initial themes or categories of information that might be relevant to my research questions. An axial coding followed in which I color-coded the relevant information according to specific themes. I then divided the themes into specific categories and again selectively coded the field notes in accordance to these categories and subcategories. The themes that were extracted during this inductive analysis (of both the interviews and the field notes) were based upon my research questions.

RESULTS

Sharon Edwards' Classroom



The description of Ms. Edwards' classroom is based upon my field notes. When a visitor first arrives in Ms. Edwards' kindergarten classroom they would be struck by the lack of conventionality typical to a classroom. There are no desks nor are there tables or chairs that are facing toward a central blackboard. Instead

the room is partitioned into interconnected learning areas that are separated by bookcases and shelves. The ambience is truly child-centered with children's words, photographs and drawings adorning the walls. There are often works in progress on the tables or shelves with handwritten "Do Not Touch" signs written by the kindergartens, reminding classmates not to put away their projects. The bookcases are overflowing with a wide variety of children's books. The shelves are full of intriguing materials and manipulatives.

The main meeting area is "the benches", where the class gathers to engage in learning activities, such as math, language arts, or science, and share important news like the weather, the date, and current events. When the children are not gathered together as a group they are interspersed throughout the classroom actively engaged in small group learning activities. A typical scenario would be: Two or three children drawing or creating 3D structures at the table by the benches, three children building with blocks in the block area, two children drawing or writing at one of the front tables, three or four children involved in science experiments at the back table (looking through microscopes, for example), two or three children sorting or counting manipulatives on the rug at the benches, two children in the hallway reading to each other and two to four children using the computers.

The autonomy of the five and six years at the computers in both the classroom and in the computer lab is quite remarkable. There is no hesitancy about choosing a computer or about opening a specific program. If the children have trouble opening the program, because the icon is not accessible through the desktop, they simply ask another child. They work independently with their own computer but they also share what they have discovered with their classmates. The children easily manipulate the mouse, follow the verbal directions, and operate the programs themselves. The kindergartners are very cooperative and more than willing to help each other out.

The day is divided into different time slots according to specific curriculum units. Math instruction and practice takes places between 1:30 and 2:30. Free choice, when the children choose what they want to do, is from 2:30 until 2:50. On the days that I observed math period coincided with gym class. Between 1:30 and 2:00 half of the class would go to gym and other half of the class would stay in the room and study mathematics. At 2:00 the groups would change. Most of my classroom observations and interviews took place between 1:30 and 3:00 on Mondays and Fridays. I also observed the children in the computer lab for a half hour on Thursday mornings. I observed the children as they interacted with one another at the computers and in the various learning areas of the classroom during math period. I also recorded Ms. Edwards's interactions with the children during this time period. Several themes were extracted from these observations and interviews. These themes were computer protocol, intellectual stimulation, unification and attraction. First I'll explain about the computer programs themselves so as to avoid any confusion. Then I'll discuss the themes.

Computer Programs

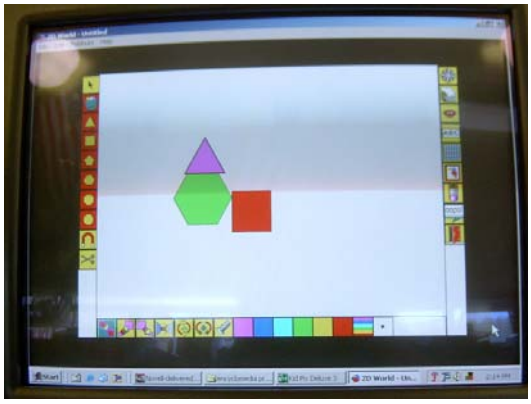
While I observed the children they used a variety of math programs. In order to fully understand the type of math the children were doing at the computers it is necessary for me to describe each in detail. These descriptions were taken from my field notes. The two software programs that were used the most often while I was observing the kindergartners were *Trudy's Time and Place House (TTPH)* and *Shape Up.* Within TTPH the children used two specific programs: *Jellybean Math* and the *Devil's Sandbox.*

Jellybean Math (TTPH) - On the screen there are two maps. The map on the right is a graph with jellybeans and an ant. The map on the left is a magnified version of the map. The back of the ant's head is at the bottom of the magnified map with the enlarged grid in front of it. The direction that the ant is moving is written at the top of the left screen. The four compass points are written

above the right map. There are arrows saying left, right or forward, below the left map and compass directions with arrows below the right map. The user guides the ant in the correct direction (North, South, East, or West) and this leads the ant to the jellybean. The ant changes shape when he reaches the jellybean. The ant's head is facing the direction that the ant is moving. The children at the computers use the arrows to direct the ant along the lines on the map to get to the jellybeans.

The Devil's Sandbox (TTPH) - On the screen is a big sandbox. The children use the grid below the sandbox to design their map. They place different symbols on the graph and the representations of these symbols are displayed on the big map. There are symbols for roads, rivers, cities, mountains, tunnels, lakes and train track. The children can choose between a 3 x 3 graph and a 4 x 4 graph. They can create a map by just clicking on the symbols or they can click on the beaver and he will show them a partially finished graph and ask the children to complete it. When the children fill in the graph correctly the map becomes animated.

Shape Up – There are various programs on the Shape Up program but they all have similar icons. Icons for the different geometric shapes (2D or 3D depending on program), a magnet to adjoin the shapes, and scissors to cut the shapes are on the left side of the computer. There is a text box and lips to pronounce the shapes on the right side. At the bottom of the screen there are icons for shrinking, enlarging, or changing the color of the shapes. The children click on the icons to acquire or alter the shapes.



Themes

Computer Protocol - The theme of computer protocol is concerned with social/emotional development through the interpersonal interactions at the computer. The categories within this

theme are adult interactions, peers helping peers, peers asking peers for assistance, and sharing the computers. Evidence of this theme was extracted from the field notes and interviews.

Adult interactions - The kindergartners are confident in their computer skillfulness and competent in providing directions to adults. Whenever I asked the kindergartners a question or asked them to show about how they were manipulating the program they were using they responded accurately and with confidence. One afternoon S11 and S18 were using the TTPH. They were moving an ant along a grid map trying to capture jellybeans. Below the map were directionals that indicated the direction that the ant was moving. I asked the children about how the program worked. “You move these things,” S11 told me, as she pointed to the directional arrows. I pointed to the directional arrows and asked what they were. “The controllers,” S11 replied. I then asked, “How do you get the ants to move in the right direction?” S18 replied, “Cause we can read.” S18 pointed to the words: right, left, forward, west, east, south, and north while she and S11 said them aloud. The ant captured a jellybean and then changed briefly into another animal. “It does that after you get the jellybean,” S11 told me.

On another day I asked S15 about a different program on TTPH. S15 gave me directions on how to use the program. “You have to try to make a map,” she told me. I asked her, “And how do you do that?” S15 replied, “ You can make a map … press on this guy.” S15 pointed and then clicked on the beaver in the corner. The Beaver said, “Please complete the sandbox map” On the computer screen was an incomplete map. Using the graph as a guide S15 had to fill in the missing parts of the map. After she filled in the graph the beaver said, “Good for you, you finished the map.” The completed map then became animated. The child explained, "and there’s the little picture that goes back.” I asked her for clarification, “How come you got that (animated) picture?” S15 explained, “They just want to make you laugh.” S15 began another map and said to me, “Watch

this." S15 placed a vertical road between the two vertical roads, on the graph in TTPH, and said to me, "You have to try to connect the maps."

In the computer lab during free choice S12 was making a picture with animated fairies using Kid Pix. I asked S12 how she made her picture. S12 clicked on her mouse and demonstrated as she explained to me: "Click on painting, then click on squirty bottle, then click on the blurry thingies, then click on the arrows to see what you want."

Peers helping peers – The kindergartners are cognoscente of their classmates at the computer. They are more that willing to help each other out. I noticed that whenever a child asked another child a question someone would give either quick, concise, understandable directions or else go over and show the child how to do it. One day in the computer lab, S16 was getting frustrated trying to exit a program. "I want to get out of here," S16 said aloud as he attempted to close down the program. S7 quickly responded to him, "You just push the person and you get out the door." Another kindergartner, S8 announced, "I don't know how to get on Kid Pix," There are several complicated steps involved to open this program. S3 and S10 went right over to her computer and showed S8 how to open the program. S3 also helped S6 do the same thing before he returned to his computer.

One afternoon two of the girls were sitting at the computers. It was during math practice and the children were using MMZZ. S8 wanted to use the same program that S7 was using, so she asked S7 how to get to that program. S7 responded, "S8, go in to the square. Press cancel. Press play."

Peers asking peers for assistance - Whenever the kindergartners are in doubt they ask each other for assistance. They don't turn to adults for help but rather ask one another. One day during math practice, four children were sitting at the computers using the Devil's Sandbox in TTPH. S4 was trying to make a map using the graph. She was confused so she turned to the child next to her. S4 asked S8, "What do I have to do now?" S8 came over to the computer and showed S4 how to complete the graph.

One afternoon in the computer lab S12 was creating a picture with fairy stamps using the Kid Pix program. S9 was interested in what S12 was making, so S9 asked S12 how she got on to the fairies. S12 came over and showed her. "This is fairyland," she announced.

Sharing the computers – Sometimes the kindergartners are asked to share the computers with a classmate. When I interviewed the children seven of them told me that they wanted to be with someone at the computer, seven of them told me that they wanted to be alone and two of them said that they want to do both. Is this because they don't want to share their computers or is it because they truly want to be alone? During her interview S15 told me, " Well sometimes we work on the computer alone but when Ms. Edwards says we have to have partners well then we have to have partners."

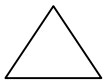
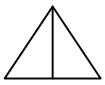
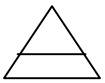
One afternoon four children were teamed up on two computers using the Shape Up program. The two children who were waiting for their turn became restless. S3 looked at the student teacher (ST) and said, "I'm bored." The ST got a box of pattern blocks for the unoccupied kindergartners to use. The two partners who were not using the computers began to make multi-pattern block shapes. ST explained that these pattern blocks were the same as the ones that were being used on the computer. When it was S3's turn on the computer his partner joined ST on the floor. The children who were not using the computers took turns making designs with the 3D pattern blocks while their partners used pattern blocks on the computer.

Intellectual Stimulation – The theme of intellectual stimulation is concerned with cognitive development at the computer. Are the children learning at the computers? If so, what are they learning? Focusing on mathematics, it is evident that the kindergartners are learning about specific mathematical concepts on the computers. The categories within this theme are learning or playing, geometry, fractions and basic mathematical properties. Evidence of this theme was extracted from the field notes and interviews.

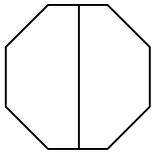
Learning or Playing – Do kindergartners think they are learning or playing on the computer? If so what do they think they are learning? From interviewing the children I found out that nine of the sixteen children interviewed said that they were both learning and playing at the computer. Four of the kindergartners said that they just play on the computer and three of them said that they just learn on the computer. From observing them during math practice I was able to record a lot of learning that was going on. When asked what they use the computer for, four of the kindergartners said that they used the computer for learning. Eleven of the children listed math related activities, including shapes, blocks, sorting, and maps. Seven of the children included math related activities in their description of what they liked about using the computer. When I asked the children specifically about what type of math they were learning on the computer I got a wide variety of responses. Three of the children told me, “All kinds of math.” One child stated. “Everything on the computer is math.” Seven of the children said they were adding and/or subtracting on the computer. Six of them said they are learning about counting. Other children listed multiplication, fractions, sorting, mapping, and building.

Geometry –The kindergarteners are learning about specific (geometric) shapes on the computers. The kindergartens are creating, describing and naming different shapes. They are able to describe, recognize and name specific shapes. One morning in the in the computer lab, the computer room teacher (CT), spoke with the kindergartners about the Shape Up program. Most of the children were

already familiar with this program. CT sat in front of a computer and showed the children how to open up the 2D activities in Shape Up. He then demonstrated how to take a geometric shape from the left side of the screen and place it in the middle of the screen. CT explained to the children, "You can use the scissors to cut the shape in half. Then click on the lips and they will tell you the name of the new shape." CT clicked on a hexagon, got the scissors and cut the hexagon in half. S12 announced "trapezoid" before CT even has a chance to click on the lips to say the same words. S3 commented, "I want to see if I cut a square in half if I get two rectangles." The children then dispersed and chose their own computers. They all opened up the SU program and opened the 2D Program. All the children took shapes and cut them with the scissors. S3 got a square and cut it in half then clicked on the lips. He said, "Rectangle" along with the lips. S3 then cut a triangle in half vertically. "How come it's still called a triangle?" he asked. He cut it again, this time horizontally. "Cool it's a trapezoid," he stated. Refer to illustration

		
A triangle	Two triangles	A triangle & a trapezoid

Across the room, S12 stated, " I didn't know an octagon turns into a hexagon." I looked at her computer and I saw two hexagons. I asked her how she did this. She demonstrated by placing two hexagons back together showing me how she took an octagon and cut it in half using the scissors and created two hexagons.

	"An octagon turns into a hexagon."

On another day, in the computer lab, S15 was using the TTPH program. She was placing rivers in diagonal lines on the graph below the map. I asked her, " Can you tell me about what you just made?" S15 replied, "Well, I'm trying to make a diamond." S15 eventually created a diamond

shape with the rivers. I noted that I saw a diamond. S17, who was sitting with us, said, "I see a diamond." S15 continued to crisscross the rivers and S17 kept a running commentary, "I see two diamonds. I see three diamonds. I see four diamonds…" S15 added, " Five diamonds." I then asked her about her map. "It's a village," she explained to me.

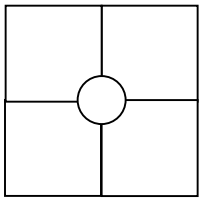
"It's a village"

One Friday afternoon, the children went to an assembly so I left the classroom. I returned to the classroom after the children and I went directly to the computers. There were elaborate designs on two of the computer screens, which had been created with the Shape Up program. I asked a student about this and I was told S1, S5, S12 and S8 had created the designs. I asked S5 about his design and he explained it to me. S5 told me that his drawing was called "Two Ships" and he and S1 created it together. He then told me: "These are two space ships and these are gypsy tubes. And there is a trap floating in outer space because I heard that on the news. This is the trap. And the Girl Ship is floating near it. The Boys Ship is this thing that has all these gypsy tubes that attach to the girls ship and then all the girls go through the gypsy tubes and into our ship so they don't get through those blades and get chopped up into space junk, S8's going through the gypsy tubes too." S5 pointed to the design and explained the different parts and the exit route.

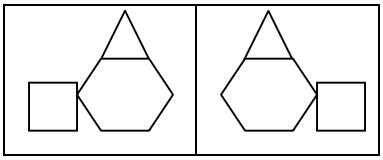
"Two Ships" "Owr Casl"

I then asked S8 about the adjacent computer design. I could see that it was a building made with geometric shapes in the "3D World" program. In small print, on the screen, the words, "Owr Casl" was written. S8 told me that it was a castle that she and S12 created together called, "Our Castle."

Fractions: The kindergarteners are learning about fractions on the computer. Many of the children are able to recognize halves, quarters, and thirds.

At one of the computers during math practice S14 was using the TTPH Program. On the screen he had created a map of two roads crossing over a lake. I asked him about the map and he told me, "It's quarters."	 "It's quarters"

During math practice one day, the children were using the Shape Up Program. The children were making mirror images on one computer, multi-block shape images on another computer, and filling in pattern block puzzles with different geometric shapes on the last computer.


"Half and Half"

Ms. Edwards walked over to the computers and spoke with the children who were using the mirror program. "Look what you did," she said to them. "You were working fractions, half and half. That's how you did gym." The children replied, "Half and half."

During one of the interviews I asked S16 about what type of math he was learning on the computer. S16 responded, "I do fractions on Devil's Sandbox (TTPH) because the Devil's sandbox is actually a fraction thingy."

Basic mathematical properties - The kindergarteners are learning about how to solve simple addition and subtraction problems. They are beginning to recognize specific features of multiplication.

Addition and subtraction - The kindergartners are beginning to recognize the symbols that represent addition and subtraction. They know how to solve simple math problems. During math practice one afternoon, Ms. Edwards was talking to the kindergartners about the graph below the map in TTPH.

She spoke with the children about how the graph was set up with three lines going across and three lines going down. She noted that the date was 03 …03…03 as she showed the kindergartners the 3 x 3 graph. S6 responded, “3 + 3 + 3 = 9.”

In the computer lab, S14 was using the counting program on Mighty Math Zoo Zillions (MMZZ). He was adding together prices. On the screen were four items each with a dollar and cents price on them. S14 chose three different items and the prices were automatically placed in a vertical equation. S14 said aloud, “3 plus 1 is 4. 3 plus 2 is about 5.” (He filled in $8.66) “That’s almost $9.00.”

$3.23
$2.21
+$3.22
$8.66

During one of the interviews I asked S8 about what type of math she was learning on the computer. She replied, “Twelve plus eleven”.

Multiplication – The kindergartners are beginning to understand that multiple exact replicates are components of multiplication. While I was conducting an interview at the table by the computers S10 was sitting at a nearby computer using the Shape Up Program. I was asking the interviewees about what type of math they were learning on the computers. S10 interrupted and said, “I am doing multiplication.” We all looked at her computer and S10 was indeed making multiple identical geometric images with the Shape Up Program.

During math practice one afternoon four symmetrical maps from TTPH were visible on the computer screens, Ms. Edwards asked, “S12, what do you see when you see these four screens?” S12 replied, “Multiplication.”

During math practice one afternoon, S7 was filling in pattern block puzzles using the Shape Up program. She gasped when she opened a new blank puzzle and saw that it was a series of connecting hexagons. S7 took hexagons from the side panel and turned them to fit into the puzzle. She quickly filled the puzzle with six hexagons and said, “Tada!” I started to say, “Wow you’re doing like …” and S7 interjected, “Multiplication.”

Unification – The theme of unification is based on the fact that the computers are integrated into the math curriculum. They are not viewed as an isolated unit but are instead seen as a segment of the overall math curriculum. The categories within this theme are math concepts are introduced to whole class; integration of math concepts; and teacher scaffolds learning. Evidence of this theme was extracted from the field notes.

Math concepts are introduced to whole class - Ms. Edwards begins math practice with a group discussion of the math concept that will be explored that day. She introduces the math curriculum to the whole class, before the kindergartners disperse to different classroom learning areas such as the block area, the writing tables or the computers. The children thus have an overview of the math that they will be learning about that day. At the beginning of math period, on a sunny afternoon, half of the class was gathered around the benches (the other half of the class was at gym). It was the first warm day of the season, over 60 degrees. Ms. Edwards began talking to her students about how warm it was outside. A discussion commenced about other places that have similar weather as this day's weather. Each child named a state or country with similar weather. Ms. Edwards then invited the children to go outside to the US map, which is permanently painted onto the black top. Each child stood on a state on the map. Ms. Edwards spoke with the kindergartners about which state they were on. Ms. Edwards then started talking about maps. She had the children move from the sun to the shade and they compared the temperatures. The class then went back inside and reconvened on the rug in the block area. Ms. Edwards told the children are that they were going to be making maps in the classroom. Some of the children would make a map with the blocks in the block area. Five children thus remained in the block area. They were going to build a map collectively and had to decide together what they were going to make. The three remaining children followed Ms. Edwards to the computers. Ms. Edwards had the children use the Jellybean Map in TTPH. In this

computer program the children began moving the ant along the grid lines to get to the jellybean. They used the compass and arrows to direct the ant to his destination. I returned to the block area and was told by the children that they had created a map of Egypt. I could see the blocks laid out representing different areas. As I stood by the block area, S8 pointed to a 3 dimensional block structure and said to me, “That’s the door to Egypt.” S7 then pointed to another area and told me, “That’s the swimming pool.”

When the other half of the class returned from gym Ms. Edwards mentioned that the block area was not available because some of the other children were using it to make a map. As the kindergartners gathered at the benches she showed them a map that S18 had drawn of her house and neighborhood. She then said to the children, “You can go to the computers to work on the jellybean maps or go to the table to draw a map.”

Integration of math concepts - Math concepts that are being practiced on the computers are interspersed throughout the classroom. When the pattern block programs were being utilized on the computers pattern blocks were being used in the classroom. If the children were doing mapping on the computers they were also making maps in the classroom (either by drawing maps or creating maps with blocks). If the children were solving addition, subtraction or multiplication problems on the computers they were also doing this in the classroom. If the children were experimenting with fractions on the computers they were also learning about fractions in other parts of the room. At the beginning of math period one day, Ms. Edwards asked the kindergartners, “Do you know how many parts an ant body has?” In front of Ms. Edwards was a baggy full of different colored foam geometric pieces. The children each gave an answer. S10 created an ant with the foam pieces. She placed one piece down for the head, one for the thorax, and one for the abdomen. A discussion about the shapes followed. After this brief demonstration the children divided up into the different areas of the room. Large foam 3D geometric shapes were in one area of the room. Pattern blocks

were available in another area. One pattern block choice was fillings in a mimeographed outline of a specific shape with pattern blocks. The children could choose from either an empty shape or a shape with the outlines of the pattern blocks in it.

The Shape Up program was on the computers. S6 was using the first computer. He had created a spherical ball with pattern blocks on the 3D program. He told me that his 3D ball was covered with triangles. On the second computer S11 was also using the 3D program. She asked me what I could see on her screen. All I saw was a square and I said so. She showed me that it was actually a cube as she rotated the square thus making the 3D cube visible. On the third computer a child had begun to make an ant on her computer. She had placed three identical circles next to each other. When she was unable to find antennas she aborted the idea and placed two small triangles at the top end of one of her three connected circles. 

Teacher scaffolds learning - Ms. Edwards scaffolds learning as she circulates around the classroom. The children do not manipulate the computers without some input from Ms. Edwards. She makes sure that the children understand what they are doing and she helps them when they encounter difficulty. She spends equal time at the computer and at the different learning areas in the room. One afternoon, during math practice, S9 was using MMZZ on the computer. She was having difficulty subtracting five from eight. Ms. Edwards quickly intervened. She asked S9 to use her fingers to solve the problem. Then S15, who was sitting next to S9 at the computers, suggested that S9 count birthdays. Using a floor rug (with birthdays on it) S9 stood on number 8 and then walked five steps and stopped on number three. Ms. Edwards then had S9 use manipulatives in which S9 took five items from eight items and ended up with three. Ms. Edwards then had S9 use her fingers once again to subtract five from eight.

During math practice one day, S14 was using the Jellybean Math program. Ms. Edwards noticed that S14 was experiencing difficulty. She sat next to him and guided S14 as he tried to make

his ant capture the jellybean. She used a little plastic animal and faced this animal in the direction that the ant on the screen was facing. She showed S14 how he needed to change the direction of the ant in order to get it to go in the right direction. She modeled this by moving the plastic ant to face the right direction. S14 used the directionals and maneuvered the computer ant so that the ant was facing the right direction. As S14 was leaving Ms. Edwards said to him, " S14, I didn't realize you were just learning North, South, East and West. I'm so glad I helped you."

Attraction –The children like using the computers. There are always children at the computers. Many of the kindergartners opt for the computers during free choice time and teacher instruction time. Evidence of the kindergartners computer amicability was extracted from the field notes, the children's drawings, and the interviews. The majority of the children wish that they could spend more time on the computer. Of the sixteen children interviewed nine said that they would like to spend more time at the computer, one child said he would like to spend both more and less time at the computer, and four of the children said that they'd like to spend less time at the computer. One of the kindergarteners admitted to me, "I want to stay on the computer for my whole entire life."

The children are happy at the computer. They sing and joke and cheerfully converse at the computer. During the interviews I asked all sixteen interviewees to draw a picture for me of them doing math on the computer. Of the twelve drawings that the children drew of themselves, with their face in view, all twelve revealed pronounced smiles.

What is it that the children don't like about using the computers? After interviewing all sixteen children I noted that the main thing that the children didn't like about the computers were technical difficulties, computer limitations, and having to leave the computer. One child admitted that sometimes it gets boring and another child said she doesn't like having a partner. Six children listed technical difficulties when asked about what they don't like about using the computer. "I

don’t like it when something’s right and they say it’s not right,” S15 told me. Five children listed limitations as something they don’t like about the computer. “ [I don’t like] that you don’t get inside,” S3 told me. Two children listed having to leave the computer as something they don’t like. “What I don’t like is when you have to click exit and they turn the lights off,” S8 told me during her interview. Turning the lights off means that its time to quit what you’re doing.

DISCUSSION

The kindergartners in Ms. Edwards’ classroom like using the computers. In fact, the only thing they don’t like about using the computer is its limitations, technical difficulties, and having to leave the their computer. They sing and hum and joke at the computer. They excitedly show each other their work. Their drawings show them smiling at the computers. They often choose to use the computers during free choice and math practice. Many of the children would like to spend more time at the computers.

The kindergartners see the computer as being both a learning tool and as a form of play. They appear competent and confident in their computer use. They give concise coherent directions to both adults and children. They easily manipulate the mouse, open and close the programs, follow directions, and correctly complete the computer tasks. If they encounter difficulty they ask one another for assistance.

Engaging in computer activities contributes to the student’s social/emotional development. The kindergartners interact with each other constantly at the computers. They ask each other for help, they readily assist one another, and they share their computer designs with their classmates and other adults. Though the children don’t always want to have a partner at the computer they are still eager to share resources with each other at the computer.

Engaging in computer activities contributes to the student's cognitive development. The kindergartners are learning about specific math concepts on the computers. The children admitted that they are learning "all kinds of math," on the computer. They listed adding, subtracting, counting, sorting, multiplication, fractions, mapping, and building as types of math they are learning on the computers. I saw evidence of knowledge gained in geometry, fractions, addition, subtraction, and multiplication since this is the type of math that I observed the most while I was in the classroom.

How is cognitive development in mathematics defined? To answer this question I turned to the Massachusetts Curriculum Frameworks for Mathematics Grades PreK-K. For the Geometry Frameworks the student should be able to: "Name, describe, sort and draw simple 2D shapes [K.G.1];" "Describe attributes of 2D shapes [K.G.2];" "Name and compare 3D shapes [K.G.3];" and "Identify positions of objects in space [K.G.4]." Throughout the field notes and as recorded in the results section of this paper all of these standards were clearly met through the use of the mathematics computer programs that the children were using in Ms. Edwards' classroom. The kindergartners were able to name, describe, and sort 2D shapes. They were able to describe the number of sides and number of corners (the attributes) of 2D shapes. They were able to name and compare 3D shapes and identify positions of objects in space (beside, inside, next to, above, etc.).

Within the category of Number Sense and Operations there was one framework that addressed fractions "Understand the concepts of whole and half [K.N.5]" and two frameworks that addressed basic mathematical properties: "Count by ones to at least 20. [K.N.1]" and "Use objects and drawings to model and solve related addition and subtraction problems to ten [K.N.7]."The kindergartners in Ms. Edwards' classroom not only knew wholes and halves; many of them also knew thirds and quarters. The kindergarteners were able to count the numbers of sides of the geometric shapes, the number of squares in a graph (TTPH), and tally amounts of money in MMZZ.

The kindergartners were able to solve addition and subtraction problems with objects in Shape Up and MMZZ. They also began to learn the basic concepts of multiplication.

The computers did not displace other learning areas but instead augmented them. The kindergartners were able to elaborate on what they already knew through the use of the computers. The computer activities were not isolated and distant from other learning but were instead integrated within the math curriculum. During math practice the children rotated from one math area to another. They were encouraged to either experiment with or observe both computer generated mathematics and other tangible classroom mathematics. They were always aware of the other math that was taking place in the classroom. The classroom teachers and aids carefully monitored and scaffold the learning that was occurring at the computers.

CONCLUSION

Computers are an excellent learning tool for the early childhood (K-2) classroom. Yet certain guidelines must be followed to assure their accountability. Computers must not be used in isolation. They must be properly introduced to the children so that the children know how and why they are using the program. Computers should not replace other classroom learning areas but should instead be used in collaboration with the other learning areas. Teachers need to monitor computer usage and scaffold learning when necessary. To be truly effective computers need to be integrated in with the rest of the curriculum. Developmentally appropriate programs must be used. Children should be given the opportunity to explore and experiment with the computer programs. Computers should not be used just for rote learning or to solve only specific problems.

My focus (on intellectual development) for this research study was on mathematics yet throughout this study I noticed many ways in which the computers contributed to creative thinking,

storytelling and scientific discovery. I listened as the children created marvelous stories based on their computer designs. I saw they them use programs in which they learned about properties of time, money, weather, physics, and aerodynamics. The contributions of the computer in the early childhood classroom are infinite. Yet this research design is still in its infancy stage. To my knowledge there have been very few research studies on young children's perception of the classroom computer. I feel that the implications for practice are enormous under this topic. This is might very well be the basis for another research project by this researcher.

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