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The effects of gender and prior computing experience on computer use and attitudes to computers in pre-primary schools

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THE EFFECTS OF GENDER AND PRIOR COMPUTING EXPERIENCE ON COMPUTER USE AND ATTITUDES TO COMPUTERS IN PRE-PRIMARY SCHOOLS

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USE OF THESIS

The Use of Thesis statement is not included in this version of the thesis.

ABSTRACT

The purpose of this study was to determine the effects of gender and prior computing experience on the attitudes of pre-primary age children to computers, and the extent and nature of their use of computers. The study involved 46 five-year old children from two pre-primary schools in the Perth metropolitan area. The method incorporated three data-gathering approaches characteristic of the 'descriptive' method of research - observation of the children; interviewing the children; and a parental questionnaire. The major finding of the study concluded that, in this instance, gender and prior exposure to computers were not factors affecting pre-primary children's use of or attitude to computers. This, and a number of minor findings, are also discussed.

DECLARATION

"I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any institution of higher education; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text."

Signed.

Date...22nd. September...1992.

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Introduction

Computers have been in Australian primary and secondary schools for over a decade (Newhouse & Oliver, 1989). Being a new part of educational technology, much research has been done regarding the incorporation of computers in schools. One of the recurring themes studied in this area is 'gender', and one of the recurring findings is that gender 'differences' exist in relation to student attitudes to, and use of, computers in schools.

Primary and Secondary Schools

Research during the 1980s in Australia, America and the United Kingdom has shown gender differences in student attitudes to, and use of, the computer in schools - with males exhibiting a more positive attitude and using the computer more than the females (Hattie & Fitzgerald,1987; Vasil, Hesketh & Podd,1987; Lockheed & Frakt,1984). Clarke (1990), discusses the ultimate outcome of this difference in terms of the limitation on women competing in the workforce for computer-related jobs. Of particular concern is the trend that such differences appear to become more entrenched with age (Hattie & Fitzgerald, 1987); therefore, fewer females than males are leaving school with the intention of enrolling in computer-related studies in tertiary institutions.

There seems to be general agreement in the research that as the students reach and progress through secondary school, the gender difference, with regard to computers, becomes more obvious. Some evidence suggests that this process has already begun in primary school children (Siann, Macleod, Glissov & Durndell, 1989); other researchers, however, did not find evidence of gender differences in primary school students (DeRemer, 1989; Swadener & Hannafin, 1986).

Pre-Primary School

Compared with the amount of research in this area in primary and secondary schools, there has been relatively little carried out in pre-primary schools. Of the research that has been conducted in the pre-primary setting, very little of it has specifically addressed the gender issue - the reasons for this will be discussed in the literature review. There are factors cited in the literature as contributing to the gender differences in the older children (for example, characteristics of software, prior exposure to computers); however, there is little information available to determine whether these factors are relevant to pre-primary children also.

The following questions therefore, will be addressed by this study in an effort to supply new information concerning pre-primary age students.

1) Is there a difference between the sexes regarding their attitude to the computer?

2) Is there a difference between the sexes regarding the extent to which they use the computer, and the nature of that use?

3) Does prior exposure to computers result in greater use of the computer for individual students in the pre-primary centre?

Definition of Terms

1) **Pre-Primary Children** - in Western Australia this refers to the children who are attending school the year immediately prior to the year in which they begin their first formal year of schooling; it is the year in which they turn five years old.

2) **Primary School Children** - in Western Australia this refers to the children who have commenced their first formal year of schooling - Year 1 (the year they turn six), through to the children in the last year of primary school - Year 7 (the year they turn twelve). The following year they go on to secondary school.

3) **Secondary School Children** - in Western Australia this refers to the children who have commenced the first year of secondary school - Year 8 (the year they turn thirteen),

through to the last year of secondary school - Year 12 (the year they turn seventeen).

4) Attitudes - the following definition of 'attitude' is given by Rokeach (1968, p. 457):

> An attitude is a relatively enduring organisation of inter-related beliefs that describe, evaluate, and advocate action with respect to an object or situation, with each belief having cognitive, affective and behavioural components.

This definition seems appropriate, as it is the researcher's belief that the children will demonstrate their attitudes to the computer in the following ways: (1) their ability to use the computer - cognitive component; (2) how they feel about using/not using the computer - affective component; (3) whether or not they actually use the computer - behavioural component.

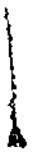
5) 'Use of' the computer - this will be categorised as follows:

a) the child is sitting at the computer using the keyboard - termed 'interactive' time.

b) the child is sitting beside a child at the keyboard, and is talking and offering suggestions as to what to do next - termed 'co-operative' time.

c) the child is standing or sitting near the computer, is not talking or offering any help to the child at the

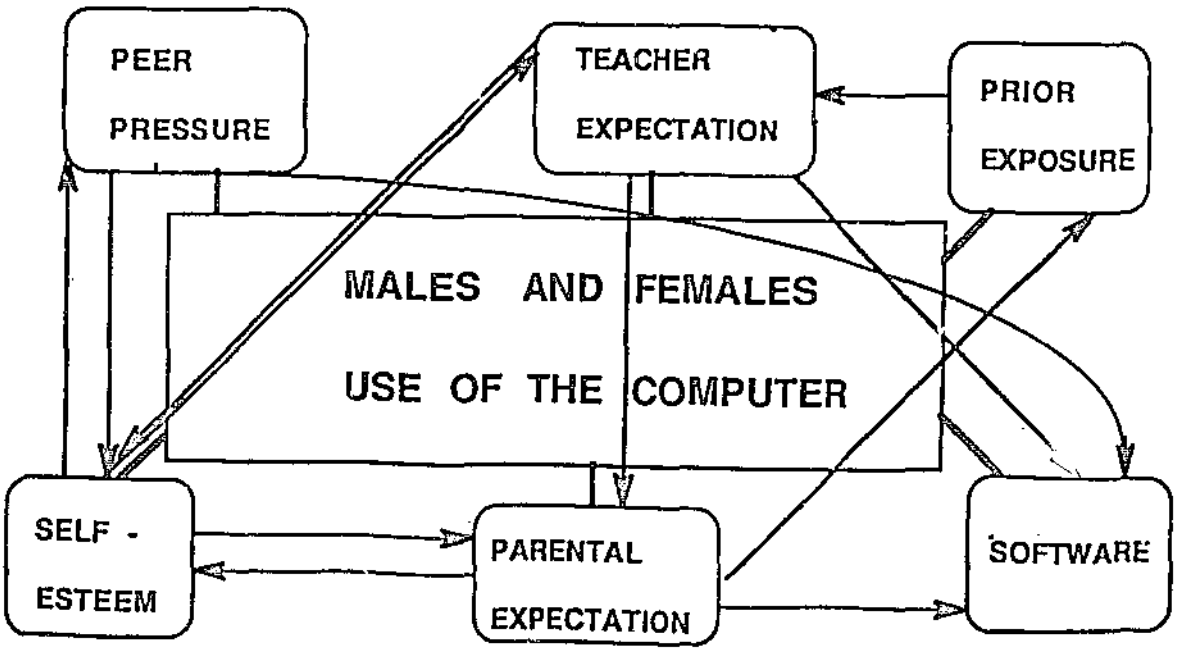
keyboard, is simply observing - termed 'passive' time. This has been chosen as a category of use as it may be the essential first step for a child who is unsure or hesitant about using the computer.



CONCEPTUAL FRAMEWORK

The conceptual framework for the study has been formed from all the variables influencing the study, and their interrelationships, which are demonstrated in the diagram below. At the centre of the concept is 'use of the computer by pre-primary children', and the children are then divided by gender.

Figure 1 Interrelationships between the variables contributing to the Conceptual Framework.



LITERATURE REVIEW

Most of the literature related to this topic comes from research-based articles, with a small portion of it being available through books and other journal articles. As there has not been a great deal of research in the use of computers in pre-primary schools, the literature review looks at related areas of research as well as the available research that has been carried out in the pre-primary area.

Reasons for Gender Differences

A number of reasons have been cited in the research as contributing to the gender issue - the common ones will be discussed here. The basis for the difference appears to lie in the way computer studies have branched from mathematics departments. Clarke (1990, p. 59), makes the point that:

> Apart from the incredible number crunching capacities of computers which makes them appear inherently mathematical, there are contextual associations between mathematics and computing. At school, computers are frequently introduced in mathematics classes by mathematics teachers who consequently orient computing to mathematics as this reflects their own background knowledge and interest.

Previous research has demonstrated a negative relationship between girls and mathematics (Collis, 1987; Fennema, 1980), and it is widely believed (Collis, 1987; Clarke, 1990), that this situation is perpetuated with computers.

Prior exposure to the computer is another factor discussed by Levin and Gordon (1989) as contributing to the equity issue. Their study, conducted on 222 students from grade 8 to 10, showed that prior exposure (in particular, having a computer at home), had a stronger effect on attitudes towards computers than sex. This research demonstrated that boys have significantly more extra-curricular exposure to computers than do girls, resulting in a more positive attitude to the computer than the girls. This result finds support in Clarke (1990, p. 57), who makes the statement that, "sex differences in computing attitudes are eliminated if the researcher controls for computing experience".

In her article, however, Clarke goes on to say that enrolment in computer courses alone does not necessarily provide girls with the experience required to develop a positive attitude. She contends that boys, in mixed-sex classes:

> demand and receive more than their fair share of resources, boys are more aggressive and competitive and take over the machines, while the girls often defer to the boys, preferring to avoid hostility and aggression (p. 57).

The next factor to be discussed follows on from prior exposure to computers, and stems from the family home. It has been demonstrated now in a number of studies (Miura and Hess, 1983, 1986; Levin and Gordon, 1989), that parents appear to encourage their sons more than their daughters to

use computers. This encouragement is in the form of boys being more likely to have a computer than girls, and parents paying more for boys than for girls for courses in computer studies. Collis (1987, p. 394) makes the point that "attitude is related to participation", so it is possible that girls are forming their attitudes to the computer in the family home through lack of interaction with computers. In the study mentioned previously by Levin and Gordon, the results showed that only 18% of the girls had a home computer, while 60% of the boys had one; related to this was the result that only 28% of the girls reported knowing how to work with computers, versus 64% of the boys. The findings from the work by Levin and Gordon on children in grades 8 through 10, demonstrate a similar pattern to the work carried out by Miura and Hess (1983, 1986), however, the latter conducted their research on mainly primary school children (grades 1,2,3 and 6,7,8).

A further finding from the work conducted by Miura and Hess in 1983 brings to notice another factor relevant to the gender issue - that of role-modelling. They found that fathers encouraged sons in computer use more than they did daughters, and that mothers rarely used the computer. Therefore daughters were not being provided with a female role-model. In their study, Hattie and Fitzgerald (1987) found that fathers were more likely to use the computer at home, but mothers, more than fathers, were more disposed towards encouraging their sons and daughters to use the

computer; they do not say if this encouragement produces a positive attitude in the daughters to the computer.

Finally, software has been seen as having made a contribution to the gender issues with computers. There is some disagreement however, about the role of software in this issue. Gilligan (1982), Miura and Hess (1983), Sanders (1984) and Forsyth and Lancy (1988), for example, found that characteristics of software (competition, male symbols, degree of difficulty of instructions), were perceived as being of more interest to males than females. Alternatively, Hattie and Fitzgerald (1987), found that students liked all uses of the computer in schools, and it was difficult to isolate many particular uses which males liked more or less than females.

The following statement by Clarke (1990, p. 58), puts this disagreement regarding the role of software into perspective, "...the absence of data which show children's or adult's direct reactions to the software indicates the need for further research in this area".

Implications for Pre-Primary Children

With the exception of one, the above factors have the potential to be as relevant to children at the pre-primary stage of schooling as they are for the older children. The exception is the relationship between mathematics and computers; this is so because pre-primary children are not

aware of the formal concept of mathematics, therefore they do not associate the computer with mathematics. However, there is no available research which demonstrates that pre-primary children would respond in the same way as older children to these contributory factors. For example, the novelty value of a computer in the pre-primary may be a prime motivator in the children using it - rather than lack of prior exposure turning them away from it. Similarly, a pre-primary teacher who displays confidence with, and a positive attitude toward, the computer may overcome lack of suitable role-modelling by parents. It is worth noting that the majority of Australian pre-primary school teachers are female, and are therefore in a position to be a female role-model to the pre-primary children.

The effect of software on children of this age is difficult to judge, and there appears to be no literature related specifically to gender preferences for software. There are journal articles that list the desirable characteristics of software for children of this age (Haugland & Shade, 1988; Anselmo & Zinck, 1987; Sherwood, 1988; Burns, Goin & Donlon, 1990), but none of these articles mention gender characteristics which may favour one gender over another.

This can present a problem if teachers, when reviewing software, are not aware of the possibility of gender bias. In their article on "Assessing Gender Bias in Computer Software", Rosenthal and Demetrulias (1988, p. 155-156),make the following point:

In the researchers'opinion most of the educational software designed for use with students in grades K-12 no longer contains blatant examples of gender stereotyping, but remnants of stereotyping occur in more subtle forms and in the documentation or packaging of the programs.

The results from this study show a significant difference when participants evaluated software for gender bias when using an evaluation form that asked very specific questions about gender bias, than when using one that did not do so.

Although it is not known if children of this age react to specific characteristics of software (for example, characteristics that are perceived by adults as being gender biased), it is possible that gender biased characteristics in software may contribute to the formation of stereotypical sex-role attitudes in children. A parallel can be drawn here between gender bias in software and gender bias in children's books. Smith (1982, p. 114), makes the point that there is overwhelming evidence that girls and women are primarily shown in passive dependent roles, and males in active, autonomous, aggressive roles in the school readers. Males are represented in larger numbers in both the stories and illustrations and are more often the main character. According to Smith, there are several studies now available which show quite clearly that books influence children's ideas about sex roles (Flerx, Fidler & Rogers,1976; Ashby & Wittmaier, 1978). It is the opinion of the researcher of this study that it is not likely that software would have the same impact on forming children's attitudes as books;

however, gender bias in software could simply reinforce what the children are seeing and hearing from other sources.

Gender Differences in Other Pre-Primary Areas

It is significant to the proposed research that previous studies in pre-primary schools have demonstrated gender differences in selection of other activities. Beeson and Williams (1979, 1980) observed that pre-school males predominantly chose blocks, wheeled vehicles, water and sand activities; the girls predominantly chose art activities. In 1983, Beeson and Williams decided to see if this choice of activity according to gender, also occurred in the family home. The parents in this study reported the same sex differences in children's play activities at home, that had been observed in the pre-school setting. In this study also, the researchers looked at the bedrooms of 96 children as an indicator of parental ideas about sex appropriateness of toys and room decor. The boys' rooms contained more vehicles, educational art materials, sports equipment, machines and military toys; girls were provided with dolls and dollhouses and domestic toys. The girls' rooms were decorated with ruffles and floral motifs; those of the boys' with animals. Parents influence their children's learning and development by the toys they buy for them, and the play they encourage. In a similar way parents may influence their children's attitude to and use of the computer - through role-modelling, encouragement and access to a computer.

More recently in a study on the use of the block corner by pre-primary children, it was revealed that in nine out of ten times observed, the block corner was occupied by boys (Goodrum,1988). Also, in a study on "Gender Inequity in Pre-Schools", Butterworth (1991), noted that girls miss out on activities such as blocks and wheeled toys, because the boys aggressively dominate these areas.

The significance of this information in relation to computer use in pre-primary schools, lies in the question,"If these gender differences and inequities occur in other areas of the pre-primary setting, do they also exist in relation to the computer"?

Computers in the Pre-Primary Setting

Compared with the amount of literature available on gender differences and computers in primary and secondary schools, there is relatively little available in this area of pre-primary schools. The following reasons may give some insight as to why this situation exists. In the researchers' experience, the main reason is that there are very few pre-primary schools that actually have a computer, therefore, there are few researchable situations. Why is it that pre-primary schools do not have computers?

The first answer to this does not lie in the literature, but seems to be a general concensus of opinion of teachers and principals - that is, pre-primary schools tend not to be seen as an area of priority for a computer in an already stretched budget; the rights or wrongs of this will not be discussed here.

The second answer is well documented in the literature, and relates to the attitudes of early childhood educators to computers; more specifically, early childhood educators have been concerned about the *appropriateness* of the use of computers at this stage of development, and whether or not computers would suit the overall objectives of pre-primary education.

The concerns of early childhood educators related to the specific developmental areas, and are discussed by Shade and Watson (1990), as follows:

a) cognitive - critics questioned children's ability to learn 'abstract' concepts from a two-dimensional screen.

b) language - educators were concerned that, at a time when children are still developing language, this process would be inhibited because they would be by themselves at the computer and not talking to others.

c) socio-emotional - this fear was similar to that for language - that is, the computer would socially isolate children, and possibly even displace important learning activities.

d) psychomotor - educators questioned whether children of this age would have the necessary fine-motor skills, eye-hand co-ordination skills, and the ability to follow the required steps.

Much of the research that has been done in the area of computers in the pre-primary classroom has addressed these specific concerns, rather than the gender issue. Gender is mentioned in the results of most of the research articles, but only in relation to the achievement levels. For example, Schaefer and Sprigle (1988), examined differences in which

pre-schoolers assimilated the terminology associated with the computer and some basic programming commands. In the results, both male and female students showed significant improvement in computer programming and mathematical concepts; the females however, were more likely to use the terminology as compared to the males. In a study by Johnson (1985) to assess cognitive and behavioural correlates of young children's interest in computers, gender differences were not significant. In 1987, Hess and McGarvey studied "The Effects of Microcomputer use on School-Readiness Skills of Kindergarteners" - no sex differences appeared in gain scores. These studies bear out the findings of research on older school children (Clarke,1990; Hattie & Fitzgerald,1987), that 'achievement' in computer studies is not affected by gender.

There have been a small number of studies directly concerned with the gender issue and computers in the pre-primary schools. The majority of these have been conducted in America, which may reflect the situation that American schools have been using computers in their pre-primary schools for longer than either England or Australia. Of the research that has been completed in this area, little consensus has been demonstrated in the results. Beeson and Williams (1984) found statistically significant differences between boys use of the computer (mean 15.5 mins.), and girls (mean 5.55 mins.), under the age of five years; with no statistically significant differences over five years of age. In this study, Beeson and Williams looked only at the

actual time the children used the computer. Lipinski, Nida, Shade and Watson (1986), found differences in pre-primary children according to the size of the group. In the classroom with the larger number of children, boys spent significantly more time at the computer than the girls; in the classroom with the smaller number of children, there was a trend for girls to spend more time at the computer than the boys - although the number of children in this classroom was insufficient for the results to be significant. Essa (1987) found no difference between boys and girls preference for the computer, even when the children were divided into younger and older groups. Finally, Elliott (1988) found that boys spend more time in the computer corner, and actually use the computer more than girls.

The scarcity of research in this area of pre-primary education, coupled with the discrepancies in the results to date, highlight the need for further studies. The fact that only one of the previously mentioned articles is Australian (Elliott, 1988), demonstrates a need also for more local information pertaining to this issue.

STATEMENT OF THE HYPOTHESES

The research evidence suggests that gender differences exist in attitudes to and use of the computer in primary and secondary school children; it also suggests that prior exposure to and previous experience with the computer can influence children's attitudes to the computer in a positive way. Although little has been written about the pre-primary situation with regard to gender and the computer, the suggestion in other research that there is a relationship between the activity chosen and the gender of the child, coupled with the gender trend with computers and older children, indicates that gender may be a factor in pre-primary children's use of the computer.

Therefore, the following hypotheses regarding pre-primary children will be tested.

Hypothesis 1

a) Boys will use the classroom computer more than girls.

b) Boys will display a more positive attitude to computers than girls.

Based on the information available about gender differences in the older children, and the differences that exist with other activities in the pre-primary school, it is important that teachers know whether or not there are differences, based on gender, in the use of the computer - so they can implement the necessary strategies to prevent this, and also to counteract 'outside' influences on the child (such as 'role-modelling').

Hypothesis 2

Prior exposure to computers will result in greater use of them by individual children in the pre-primary centre.

This information will be useful to pre-primary teachers in that they can program to ensure that all children have equal exposure to, and quality experience with, the computer.

RESEARCH METHOD

Pilot Study

A pilot study was conducted prior to the main study. The purpose of the pilot study was to test the research instruments, and to gain an indication of the time that would be required for the observation and interviewing phases of the main study.

Subjects

Participants in the pilot study were 24 five-year old children in a middle-class, Perth metropolitan pre-primary school; of these, 11 were girls and 13 were boys. At the time of the pilot study, the children had been using the computer, (a B.B.C. Master Compact) for approximately seven weeks during free-choice time. The children had been introduced to four pieces of software: *Animated Alphabet, Best Four Language, Magic Animals* and *Welcome (Master Compact)*, and these were kept in a box behind the computer. The children were not allowed at this stage of the year to turn the computer on or insert the disks - the teacher or aide did this.

Instruments

Samples of the instruments as used in the main study are contained in the Appendix.

1) An 'observation recording sheet' was designed by the researcher to incorporate the name and gender of the child, and the extent and nature of his/her use of the computer. A small area was also designated for anecdotal information at the time of recording.

2) The children were interviewed according to a pre-determined set of questions.

3) The researcher designed a questionnaire for the parents in order to determine the children's prior exposure to the computer. An explanatory letter accompanied the questionnaire.

Procedure

Prior to the commencement of the pilot study, permission was sought for the study from the principal and pre-primary teacher. The teacher met with parents to describe the research and the parents were happy for the study to proceed. The pilot study began on the first day of commencement of second term. As there was only a week available in which to conduct the pilot study, the children were observed using the computer for three days, interviews

were conducted on the fourth day, and the parental questionnaires were also given out on the fourth day - these were collected the following week. Children only attend school for four three-hour sessions per week in Western Australian government pre-primary schools.

Pre-primary school programs need to be flexible to accommodate other happenings (for example, going to the library); this may mean the time for free-choice of activities could be curtailed. This was the situation with the pre-primary school under observation, resulting in free-choice time over the three days of observation varying from twenty minutes to one and a quarter hours. As this was a pilot study, and the researcher needed as much experience as possible observing the children, the decision was made to observe the children for the total free-choice time each day. To make identification of the children easy, all children wore a name label.

For ease of recording the information, codes were used for the categories of 'use of' the computer:

* Interactive =I;
* Co-operative = C;
* Passive = P.

During the observation time the researcher had full view of all children at the computer, as well as the whole pre-primary classroom - therefore, it was not obvious that the

researcher was focusing on the computer. On the second day of observation another observer attended the session for a 'reliability check' (observer reliability was estimated at 98%). This person occupied the researcher's usual place for observing the children, with the researcher seated at the 'colouring/drawing' activity table. It became obvious that the researcher's presence at the table was attracting children to it, and therefore, possibly away from the computer - it was decided therefore, that the researcher should not participate or intervene in any activities during observation time.

On the fourth day of the pilot study some of the children were interviewed. The interviews were conducted individually in the relative quiet of the teacher's office, and all interviews were tape-recorded. Time constraints meant that not all the children were interviewed.

The parental questionnaires were given to the parents by the teacher on the fourth day. The accompanying letter requested they be given back to the teacher in four days time.

General Discussion

The purpose of the pilot study was not to test the hypotheses, but rather to test the instruments, to try to expose any unforeseen problems, and to get an idea of timing (with interviews and questionnaires). All of these objectives were achieved. The instruments and observation techniques were subsequently refined, and information regarding timing was gained. The changes made to the *observation sheet* related to the elimination of unnecessary aspects of the sheet; for example, there was an area allocated for recording whether or not the children used a printer, and, as a printer was not available to the children, this was deemed unnecessary information. A second area eliminated from the sheet related to the choice of software by the children. The teacher, however, not the children chose the software, again, rendering this part of the sheet unnecessary. Changes made to the *set of questions* (used when interviewing the children) related to condensation and lessening of the number questions asked. In a similar manner, questions seen to be unnecessary and irrelevant on the *parental questionnaire*, were eliminated. A description of the main study follows.

The Main Study

Subjects

Subjects for this study were five-year old children from two predominantly Caucasian pre-primary schools in the Perth metropolitan area. All the children in one five-year old group from each pre-primary Centre were included in the study, making a total of forty-six children.

The two schools participating in the study were chosen on the basis that they fulfilled the requirements of the researcher - these being that the pre-primary centres had a computer on a permanent basis and the children were allowed to choose it as an activity during free-choice time; and that the pre-primary centres had at least one group consisting of only five year old children (that is, the year the children turn five). As prior exposure to computers outside the pre-primary centre could not be controlled for, it was also essential that all children attending the pre-primary centres had received equal exposure to the classroom computer. The pre-primary centre had to be co-educational. As details stating which government pre-primary schools have computers were not available, the researcher selected the two participating schools by telephoning pre-primary schools and ascertaining initially whether or not they had a computer, and if they did, by then finding out if they fulfilled the above stated requirements, and finally, by asking the pre-primary teacher if she would be willing to

participate in the study. The two schools chosen were the first to fulfill the requirements, and were willing to participate in the study. No school refused to participate in the study.

Instruments

These were refined following the pilot study.

1) The time and nature of the use of the computer was recorded on an 'observation recording' sheet. This sheet was designed by the researcher to accommodate the required information (see Appendix A).

2) The attitude of the children to the computer was determined through individual interviews with the children, by the researcher. A set of questions for the interview had been compiled, and these were decided upon following consideration of previous efforts (Charmer, 1990), to ascertain attitudes in young children (see Appendix B).

3) The children's prior exposure to, and previous experience with computers were ascertained from the parents in the form of a questionnaire (see Appendix C).

Design

The main research method used was the 'descriptive' mode (Gay, 1990, p.11). The study involved two complete groups of five-year old children with the total numbering forty-six children. Each group was subjected to the same procedures involving observation, interview and parental questionnaire.

Procedure

Both schools were subjected to the same procedures described below.

In the term prior to the collection of the data, the researcher talked to the parents of the children involved in the study. This served a number of purposes including:

1) describing the study to the parents and explaining the reason for it;
2) gaining the co-operation of the parents for their part in accurately filling in the questionnaire;
3) obtaining written permission from the parents for their children to participate in the study.

Immediately prior to the collection of data in the schools, the researcher spent two sessions with the groups of children involved in the research. This was a specific request from both teachers, in order to give the children

time to get used to having the researcher around, and therefore be more comfortable with her.

Once the period of familiarity with the researcher was completed, the researcher then began the 'observation' phase of the study. All pre-primary schools had a length of time during the session when the children were permitted to select activities of their own choice. A typical session was usually three hours, with the 'free choice' time ranging from a half hour to one hour. It was during this free choice time that the researcher observed the children using the computer. The children were observed for the total time allocated to free choice per day for twelve days (that is, three weeks). The observer did not participate or intervene in any way with the children or activities during the observation time, as this could have attracted children to or away from the computer. The codes used in the pilot study for recording observations, were applied to 'use of' the computer. Observer reliability was checked by using a second observer for a portion of the time in each school, and then comparing the results of the observers against each other. Observer reliability was estimated at 97%, with only two minutes discrepancy between the two observers in sixty minutes of observation. When the observation time was completed, the researcher interviewed the children. This sequence was considered to be important, as interviewing the children prior to or during the observation time may have alerted them to what the observer was doing, and therefore may have artificially increased or decreased the time and/or

nature of the children's use of the computer. It was important that only the one person (the researcher) interview all the children, as this maintained continuity in the questioning technique. The interviews were carried out with each child individually, and were conducted according to a pre-determined set of questions; however, it was the responsibility of the interviewer to respond to the children's answers in order to gain more information or to attempt to clarify an answer. The interviews were taped.

The parental questionnaires were sent home following the observation time (during the interviewing period), while the researcher was still in the school. Again, this sequence was deemed important so the parents did not encourage their children, as a result of the study only, to use the computer at school. It was also important to give the questionnaire to the parents during the interviewing time, as the researcher was still in the school and therefore able to encourage the parents to return the completed form and to answer any queries they may have had with it.

Limitations of the Study

A limitation of the study lies in the way the pre-primary schools involved were selected. The selection was not truly random, therefore the results were not able to be generalized to other pre-primary schools.

The researcher was also aware that it is difficult to obtain valid data pertaining to 'attitudes' from this age group of children. The view has been taken however, that this difficulty should not preclude a valid attempt, by the researcher, to obtain this type of data.

Role of the Ministry of Education

The Ministry of Education was informed in writing regarding the nature of the research and the schools involved. Written permission was obtained from the Ministry to proceed with the study.

Data Analysis

This was achieved through mainly quantitative methods. A small amount of qualitative material from the children's interviews was used to illustrate various points.

Statistical analysis was conducted on the data collected when observing the children using the computer and on the number of children who had prior exposure to computers; descriptive analysis was conducted on the data gained during the interviews.

Quantitative

Two problems presented in relation to the analysis of the 'observation' data. The first of these was caused by the different proportional representation of boys and girls; the second related to the fact that there would not be a uniform amount of time allocated to 'free-choice' each day - which meant that the children were observed for varying time periods.

These problems were addressed by an analysis based on the following procedure:

1) The number of minutes each girl and boy used the computer per session was determined.

2) The minutes (for each boy and girl) were then totalled for the entire observation phase, and this cumulative total per child was expressed as a percentage of the total amount of observation time.

3) The mean and standard deviation for girls and boys use of the computer were then estimated from the percentages.

4) The analysis then involved the application of a t-test to ascertain the level of differences.

5) These analyses were conducted for each of the dependent variables - interactive, co-operative and passive use of the computer.

The application of a t-test was also used to ascertain the level of difference between children's use of the computer and whether or not they have had prior exposure to computers.

The questions in the interview had been designed in a manner that enabled the researcher to ascertain the number of

children (boys and girls) who gave a particular response. The number of responses were then expressed as a percentage of the number of boys or girls.

RESULTS

One aim of the study was to ascertain if there were any differences, based on gender, in attitudes to computers and in the amount of computer use by pre-primary aged children. This aim provided the basis for investigations concerning Hypothesis 1. These investigations involved comparisons between the boys' and girls' amount and type of computer use, and responses to questions during interviews.

A second aim of the study was to examine whether prior exposure to computers affected pre-primary children's attitudes to computers, which would manifest in greater use of the computer in the pre-primary centre by these children. This aim provided the basis for investigations concerning Hypothesis 2. These investigations involved the collection of data regarding prior exposure to computers, and analyses of the data to determine the effect, if any, on individual children's use of the computer. The results of the data analyses related to the two hypotheses follow.

HYPOTHESIS 1

(a) Boys will use the classroom computer more than the girls.

To determine whether boys used the computer for significantly more time than girls, and whether significant differences existed between boys and girls in the type of use, an unpaired t-test was conducted - the variables being gender (F and M), and:

a) children's cumulative total of time spent at the computer (expressed as a percentage of the total time available)

b) children's cumulative total for the three different types of use (expressed as a percentage of the total time available).

The results of the analyses are given in Table 1

Table 1 Results of an unpaired comparison t-test using gender and children's time spent using the computer

GENDER	NUMBER OF CHN.	MEAN	UNPAIRED t-value	PROBABILITY (1-tail)
F	28	3.3	.33	0.3685
M	18	3.05		

GENDER & % OF TOTAL TIME

F	28	1.98	.69	0.2454
M	18	1.62		

GENDER & INTERACTIVE % OF TOTAL TIME

F	28	1.21	.17	0.4324
M	18	1.15		

GENDER & CO-OPERATIVE % OF TOTAL TIME

F	28	.09	1.69	0.0487*
M	18	.26		

GENDER & PASSIVE % OF TOTAL TIME

*.....significant at 95%

The 'means' given in Table 1 indicate the average amount of time in minutes for the boys and girls use of the computer.

The t-value of .33 for gender and total time spent using the computer was not significant at the 95% level of confidence, and so the data do not support the hypothesis that boys use the computer in the pre-primary Centre more than girls. The t-values for the 'interactive' (.69) and 'co-operative'

(.17) use of the computer and gender were also not significant at the 95% level of confidence, further demonstrating that the data do not support the hypothesis that boys use the computer more than the girls.

The only result significant at the 95% level of confidence was that between the boys and girls in the 'passive' type of use (t-value 1.69, p=0.0487), indicating that, of the passive users, the boys use the computer in this mode more than the girls.

HYPOTHESIS 1

(b) Boys will exhibit a more positive attitude to computers than girls

To determine whether boys displayed a more positive attitude to computers than girls, the children were interviewed individually, and their answers collated by determining the number of children who gave the same or similar response to a question, and by expressing this as a percentage of the number of boys or girls. The results are shown in the following tables.

Table 2 Results from Question 1: " What do you like doing the most - playing with blocks, doing a painting or using the computer?"

	BLOCKS	PAINTING	COMPUTER
GIRLS (N=28)	3 (10.71%)	8 (28.57%)	17 (60.71%)
BOYS (N=18)	7 (38.88%)	4 (22.22%)	7 (38.88%)

The presumption underlying Question 1 was that if the boys had a more positive attitude to computers than girls, they would be more likely to choose the computer over the other activities, and the girls less likely to choose the computer

than the alternative activities. The results from Question 1 do not support the hypothesis that boys have a more positive attitude to computers than girls.

Question 2: " Why do/don't you like using the computer?"

This question was designed to find out which children did and did not like using the computer, and therefore, if boys liked using it more than the girls; and also, to ascertain whether there were different reasons between boys and girls for liking/not liking to use the computer.

Table 3 Results from Question 2

	LIKE TO USE COMP.	DO NOT LIKE TO
GIRLS (N=28)	22 (78.57%)	6 (21.42%)
BOYS (N=18)	13 (72.22%)	5 (27.77%)

These results do not support the hypothesis that boys have a more positive attitude to computers than girls.

The overwhelming reason given by both boys and girls, in this study, for liking to use the computer was "to play games". Of the thirteen boys who like to use the computer, all of them (100%), stated "playing games" as their reason; of the twenty two girls who like using the computer, sixteen

(72%), gave "playing games" as their reason. Five of the remaining six girls gave the following reason for liking to use the computer, "because I like pressing the buttons".

Table 4 Results from Question 3: "What do other people use computers for?"

	RESPONSE	DID NOT KNOW
GIRLS (N=28)	14 (50%)	14 (50%)
BOYS (N18)	10 (55.55%)	8 (44.44%)

The difference in these results is not sufficiently large to support the hypothesis that boys have a more positive attitude to computers than girls.

The basis for this question was that if the boys have a more positive attitude to computers than girls, they may also have a greater knowledge about them (for example, other uses for computers), than the girls.

Table 5 Results from Question 4: "Who do you think uses the computer the most - boys or girls?"

	GIRLS	BOYS	EQUAL
GIRLS (N=28)	18(64.28%)	9(32.14%)	1(3.5%)
BOYS (N=18)	5(27.77%)	9(50%)	4(22.22%)

Table 6 Results from Question 5: "Who do you think is best at using the computer - boys or girls?"

	GIRLS	BOYS	EQUAL
GIRLS (N=28)	23(82.14%)	3(10.71%)	2(7.14%)
BOYS (N=18)	6(33.33%)	10(55.55%)	2(11.11%)

The presumption behind Questions 4 & 5 was that the boys would display a more positive attitude to computers than the girls by responding that boys use the computer more and are the best when using it; conversely, if the girls had a less positive attitude than the boys, then they would also respond that the boys use it more and are the best at using it.

Again, the results to these two questions do not support the hypothesis that boys have a more positive attitude to computers than girls. Question 5, in fact, demonstrates that the girls rate themselves quite highly in terms of "who is best at using the computer".

Table 7 Results from Question 6: "Do you think computers are hard to use?'

	YES	NO
GIRLS (N=28)	7 (25%)	21 (75%)
BOYS (N=18%)	5 (27.77%)	13 72.22%)

If boys had a more positive attitude to computers than girls, it was thought they would respond to Question 7 that computers are not hard to use, more often than the girls. Once again, the data do not support the hypothesis that boys have a more positive attitude to computers than girls.

HYPOTHESIS 2

Prior exposure to computers will result in greater use of them by individual children in the pre-primary centre.

To determine whether children with prior exposure to computers used the computer at the pre-primary centres studied more than those children who had no prior exposure, an unpaired t-test was conducted - the variables being whether or not the children had access to a computer at home or elsewhere, and the children's total, interactive, co-operative and passive use of the computer (expressed as percentages of the total time available). The results are shown in Table 8.

Table 8 Results of an unpaired comparison t-test using whether or not the children have a computer and the amount of time spent using the computer

Has a Comp.	Number of Chn.	Mean	Unpaired t-value	Probability (1-tail)
Y	8	2.54	.852	0.1994
N	38	3.34		

HAS COMPUTER & PERCENTAGE OF TOTAL TIME

Y	8	1.42	.773	0.2218
N	38	1.93		

HAS COMPUTER & INTERACTIVE PERCENTAGE OF TOTAL TIME

Y	8	1.09	.309	0.3739
N	38	1.21		

HAS COMPUTER & CO-OPERATIVE PERCENTAGE OF TOTAL TIME

Y	8	.013	1.353	0.0915
N	38	.188		

HAS COMPUTER & PASSIVE PERCENTAGE OF TOTAL TIME

The t-values (total=.852; interactive=.773; co-operative=.309; passive=1.353), are not significant at the 95% level of confidence, and so the data do not support the hypothesis that children with prior exposure to computers will use the computer in the pre-primary centres studied, more than those who have not had prior exposure.

DISCUSSION AND CONCLUSIONS

FINDINGS

Two major findings were derived from the research. The first was that there was no significant difference (with the exception of 'passive' use of the computer) between the boys and girls use of, or attitude to the computer in the pre-primary centres. The second finding revealed no significant difference in the use of the computers in the pre-primary centres between the children who had prior exposure to computers and those who had not.

INTERPRETATION OF FINDINGS

Differences between boys and girls use of computers

Boys are unlikely to use computers more than girls in the pre-primary centres studied.

This finding is a result of the rejection of Hypothesis 1(a), and indicates that, despite the significant difference in the 'passive' type of use, boys and girls in pre-primary centres use the computer for similar amount of time. This result may be due to a number of factors.

It cannot be said that these children are too young to be influenced with regard to male and female roles, as gender

differences have been demonstrated in the children's choice of other pre-primary activities, which have been attributed, in part, to the home environment (Beeson and Williams, 1979; Butterworth, 1991; Goodrum, 1988). Computers however, are a relatively recent phenomenon in Australian households, with comparatively few having a computer (as has been demonstrated in this study with eight out of forty-six families owning a computer). It may be said therefore, that pre-primary children have little or no expectation or pre-determined ideas regarding who should or should not use computers - resulting in equal use by both genders.

Coupled with this possible lack of expectation on the part of the children, is the notion that a strong female role-model exists for the female pupils in the form of the teacher. Previous research (Clarke, 1990), has suggested that *lack of* suitable role-models for girls, may have contributed to differences in use of the computer in older children.

The *novelty* value of the computer cannot be overlooked in this situation, as the majority of the children (82.60%), had no prior exposure to computers, deeming it interesting to boys and girls alike.

The software used by each pre-primary centre may also have contributed to the equity in use of the computer. In School A, three pieces of software were used (Animated Alphabet, Shopping Spree, and Moving Day); in School B, one program

(Number Copter), featuring a variety of number games, was used (see Appendix E for detailed descriptions of these programs). Generally speaking, these programs lacked the characteristics (for example - competitiveness, aggression, fast action), which have been described in previous research (DeRemer, 1989; Gilligan, 1982), as being more appealing to boys than girls. Also, the titles of these programs were such that they simply described what was likely to happen in the games (for example, Moving Day involved moving animals to a new farm). This is thought to be an important characteristic of software, as a title may have the ability to attract one gender more than the other. The characters that appeared in the games could be described as *gender-neutral*, which again is an important factor for appeal of the software to both genders.

Boys are more likely to use the computer in the 'passive' mode more than the girls.

This finding is a result of the decision by the researcher to describe the different types of use of the computer by the children (see Chapter 1); but it cannot be described as an acceptance of Hypothesis 1, as it constitutes only a part of the hypothesis, and represents a small portion of the children's use of the computer. It is difficult to understand why the boys displayed significantly ($p=0.04$) more use of the computer in this way than the girls.

One explanation may have been a preference on the part of the boys initially to observe others (that is, the girls), using newly introduced software (Moving Day, Shopping Spree), before using it themselves. This explanation however, goes against the findings of Forsyth and Lancy (1988), who found that girls tend to wait for explicit instructions to be given, whereas boys are more likely to engage in immediate trial and error interaction with new computer programs. An extension of this explanation may lie in the tendency (derived from the researcher's observations) for the girls to get to the computer before the boys, forcing the boys to wait (and therefore, observe), more than the girls.

Another interpretation of the finding may be that boys were more "distracted" by the computer whilst moving between different activities - resulting in them observing what was going on with the computer, and then moving on to their original destination. This situation is given as a possible explanation as, in both schools, the children had to pass the computer to get to the block corner. 'Location of the computer in the pre-primary centre' is discussed under the heading of 'Observations' (p. 75) in this study.

Differences between boys and girls attitudes to computers

Boys are not likely to have a more positive to computers than girls in the pre-primary centres studied.

This finding is a result of the rejection of Hypothesis 1(b), and indicates that boys and girls in the pre-primary centres chosen as the focus for this study, possess similar positive attitudes to computers. This finding may be explained by the same factors influencing use of the computer by both boys and girls - that is, lack of pre-determined ideas regarding attitudes to computers; role-modelling of positive attitudes to computers by female teachers; the novelty value of computers (children of this age will display a positive attitude to almost anything new and interesting); and the use of gender-neutral software, which appeals to all children equally.

Although levels of statistical significance have not been calculated on the data from the interviews, the percentages gained in this study from the boys and girls responses indicate that the girls tend to have a slightly more positive and confident approach to computers. In Question 1, for example, 60.71% of the girls (N=28), selected the computer as the preferred activity, while 38.88% of the boys (N=18), did so. This result, however, must be viewed in the light of 38.88% of the boys and 10.71% of the girls,

selecting 'blocks' as their preferred activity - as previous research (Butterworth,1991; Goodrum,1988), has demonstrated greater use of blocks by boys than girls.

Further indication of the girls more positive attitude was given in the responses to Question 4, with 64% of the girls stating that girls used the computer the most, and 50% of the boys stating that boys used it the most. The majority of children were unable to give a reason as to why they gave their particular response to Question 3, or simply said "because they like to use it"; the following quotes however, give some indication of the children's thinking with those who were able to justify their answer:

> Because there are more girls than boys (from two girls)
>
> Because the boys use the blocks more (from one boy, and one girl)
>
> Because the girls always get there first (from two boys)

In response to Question 5, 82% of the girls thought the girls were best at using the computer, and 55.55% of the boys thought the boys were best.

As with the previous question, the majority of children were not able to substantiate their answer, or their responses tended to be explained from an "egocentric" viewpoint:

> Because I am best (from one boy and one girl)
> Because David is best (from a boy)
> Because Daddy is bigger and stronger than Mummy (from two boys)

Again however, some children gave very perceptive answers:

> Because girls use it the most (from six girls)
> Because boys do not use it much (from one girl)
> Because girls look after the computer the best (from four girls)

It was the boys who tended to give the egocentric responses, or were unable to give any reason. With the exception of the boys stated above, the boys' reasons, where given, did not have a common thread. Although "quality" of the responses was not an aspect of the research, it is worth noting that not only do the girls appear to be positive about the computer, but they seem to have greater insight than the boys as to why this is so.

In response to Question 6, 75% of the girls and 72% of the boys declared the computer easy to use. This positive result for both boys and girls may be related to the fact

that the children only had to learn the relevant parts of the keyboard for each game - they did not turn the computer on, load the disk, access the games, exit from the program or turn the computer off. The children's responses as to why they considered the computer easy to use lend credence to this interpretation.

Of the children (girls=8/28; boys=5/18), who were able to say why they thought computers were easy to use, six girls and three boys gave "because pushing the buttons is easy", as the reason. Interestingly, the children who said they find the computer hard to use (girls=7/28; boys=5/18), three of the girls and three of the boys, stated that "it is hard to know which button to press", as their reason.

Differences between use of the computer by children who have had prior exposure and those who have not

Children who have had prior exposure to computers are not likely to use the computer more in the pre-primary centres studied than those who have not had prior exposure.

This finding is a result of the rejection of Hypothesis 2, and indicates that children in pre-primary centres will use the computer whether they have had prior exposure to them or not. This finding, as with the earlier findings, may be attributable to numerous factors.

As with "use of and attitudes to" computers, the novelty value of the computer may attract those children who have not had prior exposure. Fear of use of the computer may be overcome by instruction and demonstration that is clear, simple and logical. From information gained during the observation period, children may just leave the computer if they come across a problem and cannot proceed. The availability of on-going and immediate teacher assistance is therefore important to the children's use of the computer.

The novelty value can also be attributed to the use of the computers at school by the children who have had prior exposure to computers. The computer used at both pre-primary schools was the BBC Compact; it would be unusual to

find these in the homes of the children. The software compatible with these computers therefore, would be new to the children who have used computers previously. Software could also play a part in its own right in attracting children both with and without prior exposure to computers, with the children being able to interact with the software to produce a change. The use of appealing colours, sound effects and mobility of characters create great attraction.

Positive role-modelling by the teacher may also contribute to the children's desire to use the computer, regardless of prior experience. If the teacher is seen to be confident and competent with the computer, then the children will tend to treat it in a similar manner. Coupled with role-modelling by the teacher, is the effect on some children of *peer influence*, which can attract children to the computer, or away from it, if something else appears more interesting.

IMPLICATIONS OF THE FINDINGS

Due to the limitations of the study it is not possible to generalize the findings. The two pre-primary centres used in the study appeared to have no gender-related problems with respect to use of, and attitudes towards, computers.

> Boys were not found to have a more positive attitude to computers than girls, or to use computers more than girls in the pre-primary centres studied.

Two main implications may be drawn from this finding. The first is that children of pre-primary age may not have developed or learned the stereotyped-gender attitude to computers which the literature suggests is present in older children.

The second is that this finding implies that girls of this (pre-primary) age, have a positive, confident attitude to computers, but, again as suggested by the literature, this may change as they grow older.

Boys used the computer in the 'passive' mode more than girls in the pre-primary centres studied.

This finding inplies that children, in particular, boys, may require this time to develop confidence in using the computer. Teachers should not be in a hurry to engage actively a child who appears to be doing nothing; children learn by observation, and it may be that pre-primary boys require this time more than girls. Again, it must be emphasized that it is difficult to generalize these findings.

There was no significant difference in the use of computers between children who had prior exposure to computers and those who had not.

The implication of this finding is that pre-primary teachers should not assume that children with prior exposure to computers will automatically want to use the computer at the pre-primary centre. In fact, if the computer at school is different from the computer at home, they may be reluctant to use it - for fear of failure with something with which they are usually successful. It is important therefore, that the teacher ensures these children are using the computer at school, as the computer and its software are part of the program aimed at all children to develop socio-

emotional, cognitive and physical skills. Depending on these children's computer knowledge and skills, and their social interaction skills, teachers may encourage these children to help less confident children come to terms with the computer.

RECOMMENDATIONS FOR TEACHING PRACTICE

The importance of the factors which characterized the centres studied may be useful to teachers, as they are likely to have contributed to the findings.

1) Confidence and competence on the part of the teacher when using the computer. All teachers have a responsibility to become familiar with basic technological aspects of the computer in their centre. By doing this they will be a positive role-model to the children, and may instill in them the same confidence.

2) Knowledge of and familiarity with software. It is not sufficient for teachers to have the technical knowledge mentioned above. Teachers should become familiar with software before introducing it to the children (it is assumed here that the teacher has already evaluated the software, and that it is developmentally suitable, and is being used because it will help fulfil specific objectives related to the overall teaching program). This process of familiarization will require time for working through the software, and anticipating problems the children may have with it.

3) Quality of software. If teachers are not sure of what they should be looking for in good quality software, then it is their responsibility to use available resources (journals, peers, District Office, University lecturers,

Ministry of Education staff), to determine what constitutes good quality software, and then to apply that information to their choice of software.

4) **Teacher expectations.** Teachers should "expect" all children to use the computer, and it the responsibility of individual teachers to assess their own situation regarding gender and computer use. Armed with this specific knowledge, teachers can devise and implement strategies which will ensure equity of use and positive attitudes to the computer.

Based on the researchers' experience and observation, some of these strategies may include:

* rostering child/children to the computer to ensure all children actually go to the computer at some time
* expecting the children in the above situation to complete the exercise they begin
* allocating different groupings of children to the computer - for example:
    - all boys
    - all girls
    - 1 boy with 2 girls, and vice versa
    - 1 boy with 1 girl
    - a confident, knowledgeable child with one who is less so

The groupings would depend on the teacher's knowledge of the children. It is important that the children in these situations be expected to take turns on the keyboard, and to help each other, thus giving children a chance to use the computer in both the interactive and co-operative modes.

IMPLICATIONS OF THE METHODOLOGY

OBSERVATION TECHNIQUE

Previous studies involving the observation of pre-primary aged children using the computer have simply stated the results in terms of 'total time' for boys and girls (Beeson & Williams, 1983; Essa, 1987; Lipinski et al, 1986). In these studies there was no explanation of what constitutes "use of the computer", so it is assumed that the studies refer to actual 'hands-on the keyboard' activities. In her article, Elliott (1988), differentiates between types of 'interactive behaviours' while participating in computer based learning activities - which could be equated with this study's co-operative use, as it described showing and explaining, problem solving, arguing and general conversation. Elliott also describes children being in the 'computer corner' as opposed to actually using the computer - which is similar to this study's 'passive' mode of use.

Differentiating between these different modes of computer use appears to depict a more complete and accurate picture, and future studies in this area may consider these or similar categories of use.

INTERVIEW TECHNIQUE

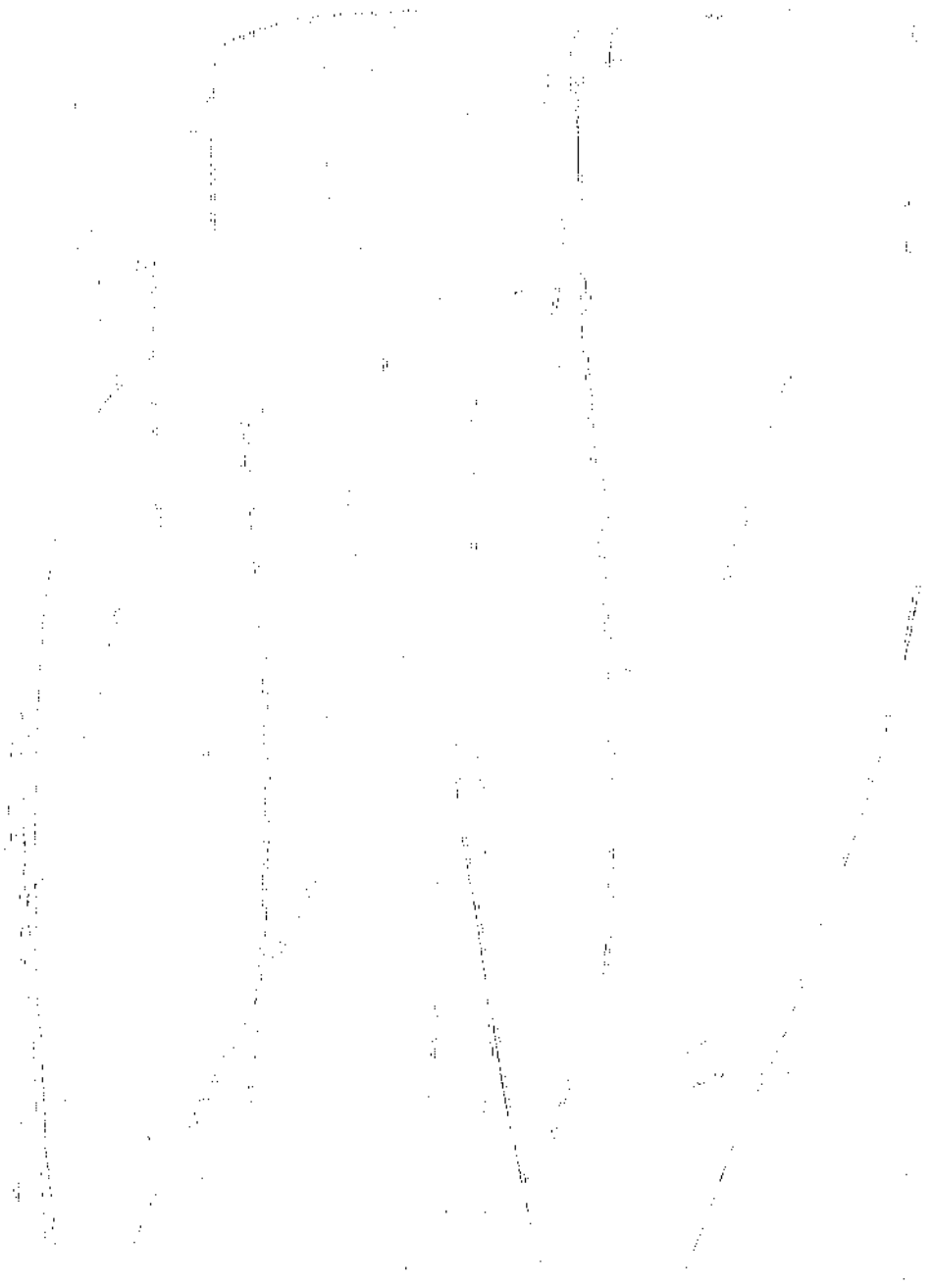
While the researcher recognizes the difficulty in obtaining accurate attitudes from children of this age, the following points are suggested for consideration by future researchers:

1) Use one interviewer only, preferably the researcher, as this will contribute to uniformity and continuity in the interview technique - which is important to the reliability of the study. If the researcher has also completed all the observation, then he/she will possess a reasonable knowledge of the children - this knowledge is taken to the interview situation and can help the interviewer link what the child is saying with the information already known about the child; this again helps with reliability.

2) Interview the children individually, away from distractions; it is important however, for the more shy children, that they do not feel cut off from the other children and their teacher.

3) Use a pre-determined set of questions and adhere to this set - which does not mean that the interviewer is unable respond to a child's answer for further information and clarification of information.

4) Limit the number of questions to those which are essential to obtaining a picture of the child's attitude, as the concentration and attention span of some of the children may not be very long. In order to do this, it is recommended that the questions be trialled before their final use, as this will give the researcher a good idea of those that are not really necessary.



OBSERVATIONS

There were a number of *observations* made from the study which are unrelated to the stated hypotheses. While some of these observations are not statistically significant, the researcher feels it is worth drawing attention to them - as a basis for future research, and for implementation of teaching strategies.

Differences between boys and girls 'mean' use of the computer.

Hypothesis 1 stated that "boys would use the computer more than girls", and, as has been reported, there was no statistically significant difference between the genders.

However, not only did the study show the boys do not use the computer more than the girls, but the girls means for all except the passive mode of use, was greater than the boys. See Table 9:

Table 9 Results of the mean use of the computer in all modes by boys and girls

	MEAN/TOTAL TIME	MEAN/I'ACTIVE	MEAN/COOP	MEAN/PASSIVE
F	3.3	1.98	1.21	.09
M	3.05	1.62	1.15	.26

It is stressed that these figures are not significant, but when viewed in the light of Hypothesis 1(a), were not expected and therefore warrant attention.

Differences between children's use of the computer who have had prior exposure to computers and those who have not.

Hypothesis 2 stated that "children who have had prior exposure to computers would use them more in the pre-primary Centre than those who have not had prior exposure". The results did not support the hypothesis. Again however, although not statistically significant, the mean use of the computers for children without prior exposure was greater in all three modes and subsequently the total time, than those who have had prior exposure. See Table 10:

Table 10 Results of children's mean use of the computer and whether or not they have had prior exposure to computers

HAS COMP.	MEAN/TOT TIME	MEAN/I'ACTIVE	MEAN/COOP	MEAN/PASS
Y	2.54	1.42	1.09	.01
N	3.34	1.93	1.21	.18

The above two sets of findings go against the trend in computer use demonstrated in the literature with older children, and indicate that these patterns may not be present in young children and that they could be acquired or learned later in life. One would ask "Why and How"? A larger study with random selection of schools would be useful for generalisation purposes, and also to confirm (or reject) these findings.

Differences in use of the computer between schools A and B

The schools involved in the study were from two different socio-economic areas - School A was in a lower socio-economic area, with School B being in a reasonably affluent socio-economic area. This aspect of the schools was not relevant to the study, but there are some statistically significant differences between the two schools and use of the computer, which deserve mention.

To determine whether significant differences existed between the schools in the use of the computer, an unpaired t-test was conducted - the variables being 'school' and the 'type of use of the computer'. The results are given in Table 11 below:

Table 11 Results of an unpaired t-test using schools and children's time spent using the computer

SCHOOL	NUMBER OF CHN.	MEAN	UNPAIRED t-value	PROBABILITY (1-tail)
A	22	3.12	.209	0.4178
B	24	3.27		

SCHOOL & PERCENTAGE OF TOTAL TIME

A	22	1.91	.235	0.4077
B	24	1.79		

SCHOOL & INTERACTIVE PERCENTAGE OF TOTAL TIME

A	22	.90	1.917	0.0308*
B	24	1.45		

SCHOOL & CO-OPERATIVE PERCENTAGE OF TOTAL TIME

*.....significant at 95%

A	22	.30	3.113	0.0016*
B	24	.02		

SCHOOL & PASSIVE PERCENTAGE OF TOTAL TIME

*.....significant at 99%

While there was no significant difference in the total and interactive use of the computer between the two schools, there was a significant difference in the co-operative (p=.0308) and the passive (p=.0016) modes of use. As was already stated this was not part of the original study, making it difficult to speculate as to why this may have occurred. Based on the researcher's knowledge of the children the following arguments could be put forward.

The difference in the interactive use may be related to the children's language and social-interaction skills - both of which appeared to be (from the researchers' experience and observations) generally more developed in the children in School B.

The difference in the passive use may be related to the children's level of confidence with the computer, with the children in School B possibly having a more confident approach than the children in School A - therefore not needing to stand back and observe to the degree that the children in School A need to. Another factor which may help interpret this difference in the passive type of use between the two schools, was the software used. During the three weeks of observation in School A, the children were introduced to two new pieces of software - which may have resulted in the children being more reluctant to use it until they had seen others do so. The software used during the three weeks of observation in School B was familiar to all the children and did not change during that time.

Location of the computer in the pre-primary centre

The observation period in School A began early in the third term following the holidays. As is usual practice in pre-primary centres, the physical layout of the centre was changed prior to the commencement of third term. During the second term the computer was located in a central position - that is, where it was easily visible and accessible, and the children had to pass by it when moving between activities. It was relocated however, for the beginning of term three, to a position which was essentially out of sight of the children (once they moved away from the 'mat' area). On the first and second days of observation in School A, three and four children respectively, used the computer. Following a

discussion with the teacher the computer was, once again, relocated to a more central place in the pre-primary centre. Consequently, on the fourth and fifth days of observation, ten and nine children used the computer. In School B, where the computer was located centrally from day one of observation, an average of seven children a day used the computer during week one. Although this is only one incident, the result of the relocation of the computer was sufficiently obvious to draw attention.

PROPOSED OTHER RESEARCH

EXTENSION OF CURRENT STUDY

Limitations affecting the generalizability of this research result from two sources - the first being the number of children in the study, and the second being the non-random selection of the schools. For the purposes of generalizability, and also for a need to see if similar results would be obtained with a larger number of subjects, an extension of this study (involving random selection of schools, larger numbers of subjects, and carried out over a longer time period), would provide valuable information.

OTHER FACTORS AFFECTING PRE-PRIMARY CHILDREN'S USE OF COMPUTERS

The significant differences between the two schools in the co-operative and passive types of use suggest a need to look at computer use in pre-primary schools based on socio-economic differences between the catchment areas for the schools.

A futher, more general area of study could be looked at under this heading - in view of the fact that the hypotheses were not supported. As the literature suggests that gender differences, in relation to computers, occur in older children, some type of longitudinal study (beginning in the

home or pre-primary centres), may be useful in identifying when the suggested change begins, and secondly, the factors contributing to the change in attitude. This information would provide teachers and parents with the knowledge necessary for implementing strategies to prevent the changes suggested in the literature, from occurring.

LOCATION OF THE COMPUTER IN THE PRE-PRIMARY CENTRE

Further evidence regarding the location of the computer in the centre and children's use of it would provide useful information to pre-primary teachers considering the layout of their centre.

THE EFFECT OF SOFTWARE ON THE USE OF THE COMPUTER IN PRE-PRIMARY CENTRES

As stated by Clarke (1990, p.58), "...the absence of data which show children's or adult's direct reactions to software indicates the need for further research in this area". While there is some research (DeRemer, 1989; Forsyth & Lancy, 1989), demonstrating older children's reactions to software, the researcher has found nothing relating to pre-primary children's reaction to different pieces of software. This type of study could provide valuable information for those writing programs for these children, and to add to the existing guidelines suggested for selecting software for pre-primary children.

QUALITY OF EXPOSURE TO COMPUTERS IN THE HOME, AND THE SOFTWARE AVAILABLE TO CHILDREN AT HOME

If the home computer is seen by a child as taking his/her parent's attention away from the child, this could result in a negative attitude from the child to the computer. In a similar manner, if the software made available for a child at home is "user unfriendly", this may also adversely affect a child's attitude to computers. A study looking at these issues could provide teachers and parents with useful information which may help develop positive attitudes to computers in all children.

CONCLUSION

Although the results have not supported the hypotheses, the results obtained from this study are positive and present an encouraging outlook regarding gender and the computer in the pre-primary centres studied. The question must be raised, however, regarding 'how, when and why' the gender difference does occur in the pre-primary to year twelve period. It is hoped that pre-primary teachers may find this methodology useful in assessing their own situation, and, if a difference is found in the children's use of the computer, that the classroom and teacher characteristics suggested earlier in this study (p. 66) will be of some benefit to them.

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APPENDICES

APPENDIX A

SHEET USED TO RECORD OBSERVATIONS OF THE CHILDREN

OBSERVATION RECORD SHEET

CHILD'S NAME	TIME ON/OFF	TYPE OF USE	ANECDOTAL NOTES

APPENDIX B

QUESTIONS USED TO GAIN AN ATTITUDE FROM THE CHILDREN

ATTITUDE QUESTIONS FOR THE CHILDREN

1) WHAT DO YOU LIKE DOING THE MOST - PLAYING WITH THE BLOCKS, DOING A PAINTING OR USING THE COMPUTER?

2) WHY DO/DON'T YOU LIKE USING THE COMPUTER?

3) WHAT DO OTHER PEOPLE USE THE COMPUTER FOR?

4) WHO DO YOU THINK USED THE COMPUTER THE MOST - BOYS OR GIRLS?

5) ARE BOYS OR GIRLS BETTER AT USING THE COMPUTER? WHY DO YOU THINK THIS IS?

6) DO YOU THINK COMPUTERS ARE HARD TO USE?

APPENDIX C

QUESTIONNAIRE FOR THE PARENTS

QUESTIONNAIRE FOR PARENTS

* Parents of.....

* Do you have a computer permanently in the family home...Y/N

* Who uses the computer the most.....MOTHER/FATHER/EQUAL USE

* Do the children in the house use the computer at home?...Y/N

* If more than one child, who uses it the most (please indicate age and sex of the child).

* Does your child who attends this pre-primary use the computer at home?.....Y/N

* For what purpose does this child mainly use the computer at home? (eg. games, writing, drawing/painting)

* Please estimate the amount of time each week your pre-primary child would spend using the computer at home.

  1/2hr 1hr 1-2hrs 2-3hrs 3-4hrs 4-5hrs 5hrs +

* If your child who attends this pre-primary has access to, and actually uses a computer regularly (other than in the home or at school), please estimate the amount of time per week your child uses this computer.

  1/2hr 1hr 1-2hrs 2-3hrs 3-4hrs 4-5hrs 5hrs +

APPENDIX D

* RAW SCORES FROM MAIN STUDY AND SCORES EXPRESSED AS A PERCENTAGE OF THE TOTAL TIME AVAILABLE

* t-values FROM GENDER AND USE OF THE COMPUTER

* t-values FROM PRIOR EXPOSURE TO COMPUTERS AND USE OF THE COMPUTER

	SCHOOL	NAME	GENDER	INTERACTIVE	CO-OPERATIVE	PASSIVE	TOTAL
			X1				
1	A	JANINE	F	25	10	0	35
2	A	NICOLE W	F	42	6	0	48
3	A	NICOLE A	F	67	12	0	79
4	A	KATE R	F	11	0	0	11
5	A	JODY	F	15	10	0	25
6	A	CARA	F	0	20	2	22
7	A	JENNIFER	F	3	8	3	14
8	A	SARA G	F	59	24	0	83
9	A	NIKITH	F	0	17	2	19
10	A	SARA T	F	16	9	4	29
11	A	RENNEE	F	9	6	0	15
12	A	CHARMAINE	F	0	0	6	6
13	A	KATE W	F	14	2	0	16
14	A	KELLY	F	27	0	2	29
15	A	COBY	F	0	0	0	0
16	A	DONNA	F	0	0	0	0
17	B	LAUREN	F	15	15	0	30
18	B	BELINDA	F	8	7	1	16
19	B	EMMA R	F	21	9	0	30
20	B	JESSICA W	F	39	33	4	76
21	B	EMILY	F	22	21	0	43
22	B	HIME	F	10	11	0	21
23	B	ALEXANDRA	F	11	12	0	23
24	B	JESSICA E	F	19	8	0	27
25	B	EMMA T	F	35	34	0	69
26	B	FIONA	F	23	22	0	45
27	B	STEPHANIE	F	8	8	0	16
28	B	CHRIS	F	10	6	0	16
29	A	KEVIN	M	18	21	9	48
30	A	ASHLEY	M	10	0	5	15
31	A	DAVID	M	26	11	5	42
32	A	JESSE	M	19	4	15	38
33	A	ROSS	M	2	13	9	24
34	A	CHRISTOPHER	M	21	9	0	30
35	B	RYAN	M	24	14	0	38
36	B	ASHLEY	M	10	21	0	31
37	B	RENE	M	29	22	0	51
38	B	ROBERT	M	4	9	0	13
39	B	MATTHEW S	M	15	9	0	24
40	B	RICHARD	M	4	5	0	9
41	B	MATTHEW B	M	39	21	0	60
42	B	SCOTT	M	41	29	0	70
43	B	DANIEL A	M	4	3	0	7
44	B	DANIEL S	M	0	0	0	0

	SCHOOL	NAME	GENDER	INTERACTIVE	CO-OPERATIVE	PASSIVE	TOTAL
			[redacted] X1 [redacted]				
45	B	JOHN	M	2	0	0	2
46	B	PETER	M	0	0	0	0

	% OF TOTAL TIME	interactive % of total	coop % of total	passive % of total
	Y_1	Y_2	Y_3	Y_4
1	3.83	2.74	1.09	0
2	5.26	4.60	.65	0
3	8.66	7.34	1.31	0
4	1.20	1.20	0	0
5	2.74	1.64	1.09	0
6	2.41	0	2.19	.21
7	1.53	.32	.87	.32
8	9.10	6.46	2.63	0
9	2.08	0	1.86	.21
10	3.17	1.75	.98	.43
11	1.64	.98	.65	0
12	.65	0	0	.65
13	1.75	1.53	.21	0
14	3.17	2.96	0	.21
15	0	0	0	0
16	0	0	0	0
17	3.28	1.64	1.64	0
18	1.75	.87	.76	.10
19	3.38	2.30	.98	0
20	8.33	4.27	3.68	.43
21	4.71	2.41	2.30	0
22	2.30	1.09	1.20	0
23	2.52	1.20	1.31	0
24	2.96	2.08	.87	0
25	7.56	3.83	3.72	0
26	4.93	2.52	2.41	0
27	1.75	.87	.87	0
28	1.75	1.09	.65	0
29	5.26	1.97	2.30	.98
30	1.64	1.09	0	.54
31	4.60	2.85	1.20	.54
32	4.16	2.08	.43	1.64
33	2.63	.21	1.42	.98
34	3.28	2.30	.98	0
35	4.16	2.63	1.53	0
36	3.39	1.09	2.30	0
37	5.59	3.17	2.41	0
38	1.42	.43	.98	0
39	2.63	1.64	.98	0
40	.98	.43	.54	0
41	6.57	4.27	2.30	0
42	7.67	4.49	3.17	0
43	.76	.43	.32	0
44	0	0	0	0

	% OF TOTAL TIME	interactive % of total	coop % of total	passive % of total
	Y1	Y2	Y3	Y4
45	.21	.21	0	0
46	0	0	0	0

	HAS COMPUTER
1	N
2	N
3	N
4	N
5	N
6	N
7	N
8	N
9	N
10	N
11	N
12	N
13	N
14	N
15	N
16	N
17	N
18	Y
19	Y
20	N
21	N
22	N
23	Y
24	N
25	N
26	N
27	N
28	N
29	N
30	N
31	N
32	N
33	N
34	N
35	N
36	N
37	N
38	Y
39	Y
40	Y
41	N
42	Y
43	N
44	N

	HAS COMPUTER
45	N
46	Y

Unpaired t-Test X_1: GENDER Y_1: % OF TOTAL TIME

DF:	Unpaired t Value:	Prob. (1-tail):
44	.338	.3685

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
F	28	3.3	2.492	.471
M	18	3.053	2.317	.546

1

Unpaired t-Test X_1: GENDER Y_2: interactive % of total

DF:	Unpaired t Value.	Prob. (1-tail):
44	.695	.2454

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
F	28	1.989	1.881	.356
M	18	1.627	1.435	.338

2

Unpaired t-Test X_1: GENDER Y_3: coop % of total

DF:	Unpaired t Value:	Prob. (1-tail):
44	.171	.4324

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
F	28	1.211	1.029	.194
M	18	1.159	.994	.234

3

Unpaired t-Test X_1: GENDER Y_4: passive % of total

DF:	Unpaired t Value:	Prob. (1-tail).
44	-1.693	.0487

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
F	28	.091	.172	.033
M	18	.26	.484	.114

4

Unpaired t-Test X_1: HAS COMPUTER Y_1: % OF TOTAL TIME

DF:	Unpaired t Value:	Prob. (1-tail):
44	-.852	.1994

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Y	8	2.544	2.324	.822
N	38	3.342	2.425	.393

1

Unpaired t-Test X_1: HAS COMPUTER Y_2: interactive % of total

DF:	Unpaired t Value:	Prob. (1-tail):
44	-.773	.2218

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Y	8	1.42	1.443	.51
N	38	1.937	1.768	.287

2

Unpaired t-Test X_1: HAS COMPUTER Y_3: coop % of total

DF:	Unpaired t Value:	Prob. (1-tail):
44	-.309	.3793

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Y	8	1.09	.927	.328
N	38	1.212	1.031	.167

3

Unpaired t-Test X_1: HAS COMPUTER Y_4: passive % of total

DF:	Unpaired t Value:	Prob. (1-tail):
44	-1.353	.0915

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Y	8	.013	.035	.013
N	38	.188	.363	.059

4

APPENDIX E

DESCRIPTION OF SOFTWARE USED BY SCHOOLS A & B DURING THE MAIN STUDY

Title of Software: THE ANIMATED ALPHABET

Target age Group : PRE-SCHOOL

Description (provided by the manufacturer):

'The Animated Alphabet' is designed for children approximately 3 to 5 years of age. It is also suitable for older children with learning difficulties. The program consists of three simple games in which the alphabet comes to life in 26 beautifully animated illustrations.
Parents and teachers can use 'The Animated Alphabet' to help their children recognize and distinguish between letters of the alphabet. As well as providing this pre-reading exercise 'The Animated Alphabet' is an ideal program to introduce children to the computer, being simple, colourful, and above all, fun. The letters of the alphabet with which the objects start are used phonetically, reinforcing sound work given in the classroom.

Title of Software: MOVING DAY

Target Age Group : 4years to 8 years

Description (provided by the manufacturer):

There are many kinds of mathematical understandings which children need to acquire if they are to make any sense of mathematics at school and beyond. 'Moving Day' enables them to develop some of these understandings by giving them the freedom to experiment with numbers, size and ratio within a context which makes sense to them. The program also helpd children to develop effective planning strategies.

'Moving Day' has been designed to foster the development of the specific mathematical skills and understandings outlined below:

* an understanding of number
* estimation skills
* proportionality and ratio
* pattern recognition
* planning strategies

Title of Software: SHOPPING SPREE

Target Age Group : Years 1 to 4

Description (provided by the manufacturers):

'Shopping Spree' generates a shopping list at a selected level of difficulty, and students shop for the items from any of six shops. A different shopping list is generated each time the program is run. The students must plan their shopping trip in order to buy all the items on their list in the minimum of steps, and they are given feedback on their success. A printout of the shopping centre may be made to assist in planning. The teacher's role is one of facilitator, encouraging discussion of alternatives between students.

Title of Software: NUMBERCOPTER

Target Age Group : 3 to 8 years

Description (provided by the manufacturers):

'Numbercopter' contains eight packages. As the children play the games they will learn to observe accurately and memorise, remember sequences, think logically, read short sentences and add and take away.

Choose the program required and the keycards that go with it. These can be stuck with Blu-Tak above the top row of keys on the keyboard. You can change the keycards to make the game slightly more challenging. The steps suggested are very small - very carefully planned to give children a good chance of succeeding and of wanting to try more.